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REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., September 4, 1930.

SIR: I present herewith the report of the Bureau of Biological Survey for the fiscal year ended June 30, 1930.

Respectfully,

PAUL G. REDINGTON, *Chief.*

Hon. ARTHUR M. HYDE,
Secretary of Agriculture.

FEDERAL WILD-LIFE ADMINISTRATION

The administration of wild life by the Bureau of Biological Survey involves research, reservation establishment and maintenance and other service activities, and regulatory functions under conservation laws. These have been popularly termed the three R's of wild-life conservation. Research in the relationships, habits, production, control, and conservation of wild life is essential and fundamental to all other work undertaken. Reservations must be set aside for the long-time benefit of the wild life that is more and more being crowded off its ancient feeding, breeding, and resting grounds by ever-increasing human occupation. Regulation of human operations in the use and enjoyment of wild life is essential to the immediate welfare of species that would otherwise be hunted to the point of extermination; control operations directed to suppress the depredations of predatory wild animals may also be termed an essential form of regulation, necessary both for the conservation of useful and harmless wild life and for economic reasons as well.

Other bureaus of the Federal Government are concerned with wild-life administrative functions, though limited for the most part to the specific areas under their jurisdiction. The Bureau of Biological Survey conducts special wild-life surveys on many such areas and cooperates in other ways with the administrative bureaus as requested. In addition, in the nature of its responsibilities as determined by Congress, the Biological Survey becomes a clearing house for information in general on the needs, habits, control, propagation, and relationships of the forms of vertebrate wild life other than the fishes. Its main field, from the time of its organization 45 years ago, has been the study of the wild birds and mammals of the country, extending, with the passage of years, to work for their conservation and control, and their propagation and utilization, including experiments in fur farming.

Increasing interest in wild-life conservation is making it every year more evident that wild-life administrators—Federal, State, and

local—must ever be on the alert for the welfare of the species under their guardianship. With all due regard for economic considerations they must bear in mind that their chief responsibility is for the protection of the wild life itself, and that as the duly constituted guardians of the various species they must be true to the trust imposed upon them. In spite of any pressure that may be exerted by organized groups and by individuals having special interests at stake they should perform their duty fearlessly and without favor. Such measures for wild-life conservation or control as are called for must be taken when dictated by thorough and careful investigation and consideration of all factors involved and of all results that are likely to follow.

Just as there must be research preliminary to definite operational programs, so it is essential to their greatest effectiveness that the results of research be made known to the public. The present facilities of the bureau do not permit the assignment of specialists to the sole duty of public lecturing and addressing conventions of conservationists, fur farmers, stockmen, and others whose work is influenced by the wild-life administrative functions of the Bureau of Biological Survey. Much, however, is being done by the bureau, both in the publication, so far as funds permit, of technical and popular official bulletins and in communicating developments to the press of the country and directly to the public by radio and other addresses given by the various members of the staff. In addition specialists of the bureau are constantly contributing articles in their own fields to the popular weekly and monthly magazines and to the outdoor, scientific, and trade journals of the country, thus effectively disseminating the information the public has a right to expect from the "wild-life service" of the Government.

OUTSTANDING EVENTS OF THE YEAR

Outstanding as mileposts affecting the work of the Bureau of Biological Survey during the year may be mentioned the following:

Completion of the food-resource surveys of all areas recommended as suitable for migratory-bird refuges, involving 189 units in 48 States, aggregating more than 3,700,000 acres, and determination of their biological fitness; and land-valuation surveys of 40 of the units, in 24 States, involving approximately 1,225,000 acres.

Authorization by the Migratory Bird Conservation Commission of the first two purchases recommended by the Biological Survey of areas under the new migratory-bird refuge program and the setting aside of two additional areas of public domain similarly recommended for the same purpose.

Congressional authorization of $250,000 for the acquisition of the necessary areas of land and water for the establishment of the Cheyenne Bottoms (Kansas) Migratory Bird Refuge, and beginning of surveys thereof under a special appropriation of $50,000.

Inauguration of a program of research on the relations of wild life to the forests, including their game, fur-bearing, and predacious inhabitants.

The placing of an order with an experienced collector in Greenland for the delivery in this country of an initial herd of 34 musk oxen for transportation to Alaska for restocking.

Participation in the International Fur Trade Exposition and Congress at Leipzig, Germany, under congressional authorization and appropriation for the purpose.

Extension of cooperative predatory-animal control to the Lake States at the request of Michigan, Wisconsin, and Minnesota, where wolves, coyotes, and bobcats have been destroying game and livestock.

Publication of a technical report on red squill as a raticide, which is making possible the preparation of a uniformly toxic product for rat control that does not seriously endanger livestock.

Reduction of the bag limits on ducks and geese, to begin with the fall season of 1930, as an immediately necessary measure for wild-fowl conservation, and its favorable reception by the people generally.

Imposition of a record fine upon a violator of the migratory bird treaty act—$2,700 for killing 90 eider ducks, which the Federal law protects by a close season throughout the year.

Creation of a committee of five members of the United States Senate, all well known for their interest in wild life, to investigate and report on measures for the conservation and replacement of land and aquatic wild-animal life.

BUREAU PERSONNEL

No changes of importance were made in the organization or higher administrative positions of the bureau during the year. It is fitting, however, here to record the death of an ex-chief and retired member of the Biological Survey, the only break of this kind in the roll of the chiefs of the organization from the time of its establishment in 1885 to the present:

Henry Wetherbee Henshaw, who served as Chief of the Biological Survey from June 1, 1910, to December 1, 1916, died in Washington, after a prolonged illness, on August 1, 1930, one month after the close of the fiscal year on which this report is made. Mr. Henshaw, who was born March 3, 1850, had been a life-long ornithologist and was well known as an all-round naturalist. His outstanding contributions to the work of the Biological Survey were his emphasis on the economic side and his furthering of the popularization of scientific information regarding birds. The passage of the first Federal migratory-bird law (1913) occurred during his term of office, as did also the first administration by the Biological Survey of the Federal regulations for the protection of migratory birds. He was the author of many books and articles on ornithology, including contributions to the series of bulletins and yearbooks of the department.

RESEARCH ON THE HABITS AND RELATIONSHIPS OF WILD LIFE

COMPREHENSIVE DATA ESSENTIAL

Progress has been made during the year in the study of problems of geographic distribution, classification, life history, and migratory movements of birds and mammals, of natural life zones, and of ecological relationships. The increasing demand on the part of wild-life administrators, research workers, and the general public for scientifically ascertained information on matters affecting the

wild life of the country, in response to the steady growth of popular interest in wild life, accentuates the need for a vigorous prosecution of research work as a basis for a properly balanced program of wild-life administration.

The essential in wild-life research is reliable information regarding the habits, the diseases and parasites, the feeding preferences, the available food resources, the natural enemies, the reproductive cycle, and the relationships to humankind. Comprehensive data and sound interpretation are required if intelligent, far-sighted action is to be taken in efforts to improve the welfare of wild life, to control inordinate increase of numbers, or to restock depleted areas, and to make necessary adjustments of wild-life interests to agriculture, forestry, livestock production, and other associated economic uses of land and water areas.

The research program of the Biological Survey is being articulated more closely with the work of other Federal and State agencies and educational and research institutions and organizations, and its extensive collections of specimens and important files of records and literature are made freely available to properly accredited investigators throughout the country.

REGIONAL INVESTIGATIONS

As a result of a cooperative investigation carried on by the Biological Survey and the Kentucky Geological Survey, a report on the wild life of the Mammoth Cave region, including the caves and their approaches, was prepared and is now in course of publication by the State agency. A report on animal life of the Yellowstone National Park also was completed for outside publication and has now been issued.

RESEARCH ON BIRDS

Established lines of research in ornithology have been continued so that information may be readily available on the classification, distribution, migration, and life histories of birds, both for general use and for the program of research on the relationships of birds and other wild life to forestry production. About 75,000 records on these subjects have been carded during the year, and a considerable number of specimens added to the collection by field workers and voluntary contributors. Of more than 1,500 specimens identified for individual correspondents and for museums, some were referred to the Biological Survey because of difficulties in identification involving special research and comparison with types and series of specimens. The list of voluntary cooperators who observe and report on the general migratory movements of birds numbers more than 500, and 53 additional individuals have submitted reports on censuses of birds on selected areas.

LOCAL STUDIES

Financial assistance contributed by public-spirited cooperators made it possible to take steps toward publication of a comprehensive report on the birds of the State of Florida. This will make available the results of several years of field and laboratory investigations by members of the Biological Survey and many of its cooperators.

It will contain a history of the ornithology of the State, an account of the known bird population, including descriptions, life histories, and ranges, and ample illustrations in color.

Two field workers of the Biological Survey contributed a comprehensive report on the birds of the Portland (Oreg.) area, which was published during the year in the Pacific Coast Avifauna series of the Cooper Ornithological Club.

The birds of the Mississippi Valley region are being studied to obtain information supplementary to that already available regarding its bird population. Special attention is being given to birds now breeding on and in the vicinity of the Upper Mississippi River Wild Life and Fish Refuge as part of the program that has been inaugurated to make thorough biological studies of Federal game preserves and bird refuges.

BIOLOGICAL INVESTIGATIONS OF MIGRATORY BIRDS

Waterfowl censuses were continued this year as last, the reports averaging about 1,800 a month. To obtain voluntary cooperation and to investigate first-hand the waterfowl areas and conditions affecting the welfare of migratory game birds, field trips were made by representatives of the bureau to Alberta and southern British Columbia, to the Pacific Coast States, to Arizona, New Mexico, and Texas, and to important waterfowl areas of the Potomac River and Chesapeake Bay. These inspections, together with reports of cooperators and investigations by other members of the staff, developed much valuable information. After conference with Canadian officials a change was made in the method of gathering information from cooperative observers. Hereafter, instead of the monthly system of reports, quarterly reports will cover conditions observed during the winter, the spring and fall migrations, and the summer breeding period, to supplement field observations and reports by members of the employed personnel of the bureau.

BIRD-BANDING OPERATIONS

Banding operations have furnished increasingly valuable information regarding the migratory movements of waterfowl and other birds. The positive data obtained make it possible to determine and chart flight lanes between wintering and breeding grounds and their relation to resting and feeding areas. The resulting information will be exceedingly helpful in establishing refuges and in settling difficult questions of fact involved in the administration of the migratory bird treaty act.

The total number of ducks and geese banded up to the close of the fiscal year was 59,771, of which 27,724 were mallards, one of the most highly prized of game birds. Other important species banded in lesser numbers were black ducks, 8,387; pintails, 9,991; blue-winged teals, 2,362; lesser scaups, 2,079; green-winged teals, 2,045; and redheads, ringnecks, and baldpates, more than 1,000 each. Localities where 100 or more waterfowl have been banded have increased to 67. They are well distributed from Alaska and southern Canada to southern California and the Gulf of Mexico. Sportsmen have cooperated heartily in reporting on the banded ducks in their bags.

Cooperating banders who operate trapping stations of all types now number about 1,750. The number of bands purchased by the bureau and issued during the year totaled 272,000, and birds banded numbered 182,263. The return records received are estimated at 10,000, representing a 33 per cent growth over the previous year. Leading research and educational institutions recognizing the scientific value of the work are participating increasingly in the banding operations. Bird-banding research is being more and more stressed in the organization of cooperative projects, and at least a dozen major trapping and banding stations have been established at universities and colleges from Maine to California.

To afford information on and to illustrate tested apparatus and technic, a Manual for Bird Banders (Miscellaneous Publication No. 58) was issued during the year. This has proved a distinct stimulus to more effective work and to application of banding to special research problems and life-history work. Two other official publications on bird banding also were issued—an article in the 1930 Yearbook, Migratory Status of Mourning Doves is Proved by Banding, and a circular (No. 118) on a method suggested for calculating the abundance of waterfowl on the basis of returns from banded birds. Better coordination of the efforts of cooperators should result from the combination of the Northeastern, Eastern, and Inland Bird Banding Associations in support of a new quarterly journal, Bird Banding, formerly issued as the Bulletin of the Northeastern Bird Banding Association. The Western Association continues to issue its own mimeographed quarterly, News from the Bird Banders.

RESEARCH ON MAMMALS

INVESTIGATIONS AND REPORTS

More extended field work was conducted than has been possible for several years, and many places throughout the country have yielded specimens of mammals and data regarding their distribution, habits, and relationships. Specimens numbering more than 1,500 were identified for institutions and individuals representing 22 States and 1 foreign country, and included many studies to determine the kinds of animals involved in economic problems. Interchange of materials needed for special study comprised 490 specimens borrowed from 7 institutions and 290 loaned to 11 institutions in 8 States and 1 foreign country. Investigators thus provided with material for work on research problems represented 16 States, Alaska, and 3 foreign countries.

A study of the ranges and relationships of chipmunks undertaken some years ago was recently completed, and the results embodied in a report issued in November as North American Fauna No. 52. A full account of the life history and economic status of the grasshopper mice also was issued in November as a technical bulletin (No. 145) of the department. In cooperation with the State College of Washington, a report was published by that institution in December on a provisional list of land mammals of that State, the senior author being a biologist of this bureau. The information presented was based primarily on specimens and notes acquired by the Biological Survey and cooperating institutions in work con-

ducted under the field leadership of the senior author. Progress also was made on studies of the mammals of Lower California, and a taxonomic revision of the group of the mountain lions was brought nearly to completion.

Studies were made of the game resources of the Southwestern region, including deer, antelope, mountain sheep, and various upland game birds. Attention also was given to the economic relationships of predatory animals and to species of value as fur producers.

DEER INVESTIGATIONS

Cooperative studies of deer with the State Game Commission of Pennsylvania were continued to ascertain the cause of lowered vitality and losses among these valuable game animals. The fact-finding committee appointed by the commission, which by request included a representative of the Biological Survey, who served as chairman, has completed a series of reports based on field and laboratory investigations, including feeding studies. Much new and important information was obtained as a result of this work, and the reports are now in the hands of the commission for publication.

The condition of deer at many other points has also been studied by representatives of the bureau in gathering data regarding their abundance, availability of food supplies, and their diseases and parasites. Further study was made of the deer herds on the Kaibab Plateau, Ariz., their available food resources, their range requirements, and the effects of their browsing on the forest. Methods of hunting to reduce excessive numbers, and of capture and transportation for restocking depleted areas, also received attention.

ELK IN WYOMING

Studies of the southern herd of elk in the vicinity of Jackson Hole, Wyo., have been continued and results of increasing value obtained. The studies include details of life history of the elk, the effect on them of predatory animals, their range and feeding requirements, and other factors affecting their well-being. When it was found that their feeding upon certain plants was responsible for lesions inducing necrotic stomatitis and causing severe losses, experimental studies were undertaken in cooperation with the Bureau of Plant Industry to determine means of eliminating such plants or of harvesting them at a season when not injurious. Assistance in the study of disease conditions was given by the Bureau of Animal Industry. An article on epizootic diseases of elk, prepared by the field specialist of the Bureau of Biological Survey and published in the Journal of Mammalogy, in May, 1930, summarized the important results obtained.

Upon request a report on the work was submitted to the Elk Commission. Cooperation has been continued also with the Forest Service of this department, the National Park Service of the Department of the Interior, and the State Game Commission of Montana in studies of the northern Yellowstone herd. At the request of the Yellowstone Park Boundary Commission, a special study, under the leadership of a bureau representative, and participated in

by the Forest Service, the State Game Commission of Wyoming, and the National Park Service, was made of game conditions in the upper Yellowstone-Thorofare region, with particular reference to elk and moose and their migratory movements.

Detailed studies also are being made of the plants upon which the elk feed, and of those they consistently avoid. The experiment station of the University of Wyoming is assisting in chemical analyses to determine nutritive properties and possible poisonous or other deleterious qualities of these plants.

Careful studies also are being made in the Jackson Hole region of the moose, deer, and antelope and their general ecological relationships.

RODENT ECOLOGY

Interest in wild-life research in the Southwest is increasing steadily as the value of the work conducted on rodents and other small mammals during the past several years is coming to be recognized. There has been a notable strengthening of the work with cooperating institutions, and further expansion is in prospect. A recent conference was held to consider the unification of research activities along these lines by the Universities of Arizona and New Mexico and the agricultural colleges and experiment stations of these States, the Forest Service, the Bureau of Animal Industry, the Bureau of Entomology, and the Bureau of Biological Survey of this department, the National Park Service and the Bureau of Indian Affairs of the Department of the Interior, the Carnegie Institution of Washington, including its desert laboratory near Tucson, Ariz., and the Game and Fish Commissions of New Mexico and Arizona.

Studies have been continued on experimental inclosures on the Santa Rita range reserve and at a number of representative points in northern Arizona of kangaroo rats, rabbits, prairie dogs, porcupines, and other rodents in relation to range forage production, to erosion and soil working, to natural seeding, and to planted seeds of forest trees.

Reports were prepared for publication by the field representative of this bureau working on the project summarizing some of the important data and conclusions on the following subjects: Ecology and life history of the porcupine as related to the forests of the Southwestern United States; methods of determining the effect of rodents on the range; and rodents as factors in soil formation and modification.

BIOLOGICAL RESEARCH IN FOREST WILD LIFE

Research by the Biological Survey on the relation of birds, mammals, and other vertebrates to forest production was begun during this year in accordance with provisions of the recently enacted McSweeney-McNary forestry research legislation. A very large amount of work in this general field had been done previously by naturalists of this bureau, and the results afford a good basis for starting the new work. In expanding the field two additional biologists were added to the staff to devote their entire time to experiments and investigations relating to animal life on forested areas, including geographic distribution and observations on life histories and general

habits. Their studies cover the seasonal occurrence and activities of birds and their migratory movements with direct reference to their beneficial or harmful relations to the forest and the value of certain species of birds and mammals as game. Facts that operate to increase or to reduce wild-life population are noted, as well as the natural and artificial conditions necessary to maintain numbers sufficient for recreational purposes, and to provide profitable use of forest lands for game production without undue interference with the seeding, growth, and utilization of trees, forage, and other forest products. This includes study of the relationships to livestock of big-game animals, such as deer, elk, and moose, and means of increasing the game-carrying capacity without detriment to legitimate livestock interests.

Experimental plots have been established at favorable points on the forests to determine the effect of rodents and other animals on growing plants and in distributing or destroying seeds of forest trees and forage plants either in natural seeding or in planted areas. The relation of denuding and burrowing species to soil formation and working and to water run-off and erosion constitutes an important feature of the investigations.

Studies are made also of the present abundance of species valuable as fur producers, their source of food supply, and their relation to game and other valuable or harmless wild life of the forest. Exact information on the place of the fur bearer as a factor in forest economy, from the viewpoint of both possible beneficial and harmful qualities, is essential as a basis for administration and determination of the maximum profitable use of land and water areas in the forests.

BIOLOGICAL INVESTIGATIONS OF INJURIOUS ANIMALS

The biological investigations of injurious animals have been concerned for the most part with identifications for the benefit of bureau representatives and of cooperators engaged in rodent and predatory-animal control. Exact information regarding the kinds of animals actually responsible for damage to crops or livestock is essential in determining the control measures appropriate, and in intelligently planning efficient measures for affording relief to producers. Certain identifications help to safeguard species that occur in the regions involved but are not responsible for damage observed, or whose habits and relationships are predominantly beneficial. Information was furnished regarding the geographic distribution, habits, and life histories of species involved in control operations or about which questions arose, and included the preparation of maps of known ranges. The large reference collections and the extensive files of information assembled from field and laboratory studies and from published sources are indispensable and are constantly used by specialists of the bureau in making identifications and compiling information requested.

EXPERIMENTS WITH MOUNTAIN SHEEP AND MUSK OXEN

In cooperation with the Alaska Agricultural College and School of Mines experiments have been made near Fairbanks in the domestication of mountain sheep. Five animals were obtained from the Mount McKinley National Park in the summer of 1929, and these tamed readily and adapted themselves promptly to handling and feeding.

The appropriation for the fiscal year 1931 provides funds to be used in obtaining and establishing at the reindeer experiment station a herd of musk oxen with a view to their reintroduction into Alaska. They were formerly native to the Territory but were exterminated there many years ago. Before the close of the fiscal year an order had been placed with an experienced collector for the delivery of 34 head of these animals from Greenland. Additional land for their use at the reindeer experiment station has been set aside by Executive order.

REINDEER INDUSTRY IN ALASKA

Problems involved in the production of reindeer in Alaska have had the full benefit of research work. Crossbreeding experiments with reindeer and caribou have progressed during the year. Reports based on a study of the reindeer herd on the Nunivak Island Reservation show clearly an increase in size and improved conformation in the crossbred animals, resulting from the introduction of caribou blood, and increased vigor and ability to rustle for food and withstand the rigorous climatic conditions. Experiments are being conducted at the reindeer experiment station near Fairbanks to determine the proportion of interbreeding that gives the most satisfactory results preliminary to the selection of improved breeding stock for introduction into the Alaskan herds.

The steady growth of the reindeer herds has emphasized the need for efficient herd and range management. Practical recommendations are made on the basis of investigations of the extent and character of the range, and of grazing practices essential to maintenance of continuous and profitable yield, for the benefit of those engaged in the industry and of Territorial officials responsible for land allotments and native herd supervision. At the request of the governor of the Territory, reindeer-production experts of the Biological Survey have been serving on an advisory committee engaged in working out plans and policies relating to grazing allotments and herd management.

Definite advance has been registered in studies of the nutritive value of the various lichens, browse, and other natural forage, and of grain, hay, and root crops produced by farmers in Alaska. In these studies carefully conducted feeding experiments are made and the condition of the animals is noted. In cooperation with the Bureau of Animal Industry thorough biochemical and vitamin studies are made of the feeds used and of the waste products of metabolism. Similar studies also are made of the chemical and physical character of the reindeer meat and its nutritive properties. In cooperation with the Bureau of Home Economics a leaflet (No. 48) was issued in November, based on studies of the palatability of reindeer meat and of the methods of preparation that enhance its attractiveness as a food product.

Investigations of the life history and habits of warble flies have been prosecuted in cooperation with the Territory of Alaska, and the Bureau of Entomology of the department, to determine practical methods of preventing their injury to reindeer. The flies and their larvae cause much distress and disturbance to the animals and greatly reduce the value of the hides for leather and garment manufacture.

Nose flies and other insect pests of reindeer also are being studied. The Bureau of Entomology has given valuable cooperation by detailing competent entomologists to undertake the fundamental studies of the biology of these parasites and of repressive measures. The conduct of these studies is very difficult because of the exigencies of reindeer handling on the vast Alaskan ranges.

Representatives of the Biological Survey in Alaska have aided Canadian officials and investigators in their efforts to determine the suitability of great areas of range land in northern Canada for reindeer production. Upon completion of a contract with Alaskan producers for the purchase by the Canadian Government of a herd of 3,000 reindeer and their delivery at an agreed time and place, arrangements were made for a representative of the Biological Survey to study practical features and difficulties encountered in starting the long overland drive. The observations made will be of value also in Alaska in connection with the transfer of herds to the vast unoccupied range lands of the interior, or for fattening and slaughter at points favorable for shipment and for the disposal of meat and other products.

A circular (No. 82), entitled "Improved Reindeer Handling," was issued during the year, to make available to the industry the results of investigations thus far conducted and to detail in a practical way the solution of problems in herd management, corralling, marking, recording as to ownership, feeding, breeding, slaughter, use of reindeer as draft animals, range use, and deleterious results of range fires and parasitic infestation.

ECONOMIC INVESTIGATIONS OF WILD LIFE

LABORATORY STUDIES

FOOD OF BIRDS

Although three employees usually engaged in the study of the food of birds were detailed to other lines of work, employment of additional assistants made possible some progress on standing lines of investigation, which latterly had to be more or less neglected, notably the study of the food habits of the diving ducks and of the hawks and owls. Examinations were completed of stomachs collected in Florida during an investigation of birds in relation to the insect pests of celery. Information resulting from this work as well as from similar studies made in previous years will be combined for final publication with findings of an investigator in the Bureau of Entomology.

Special investigations as usual were a feature of the work, and included examinations of the stomachs of prairie chickens and sharp-tailed grouse from Wisconsin, as part of a general study of the life histories of these birds; a study of woodpeckers and nighthawks from Montana, to learn their status as enemies of the mountain pine beetle; of butcher birds (shrikes) from California, with respect to alleged destructiveness of other birds; of fish-eating birds from Montana; and of a variety of species from Florida, of which knowledge of the feeding habits is meager.

FOOD OF OTHER ANIMALS

A considerable number of examinations of mammal stomachs were made, principally of moles, collected to learn their relation to the bulb industry on the Pacific coast; of muskrats from Atlantic coast marshes, to increase information on their food habits; and of predatory mammals, to learn whether their popular classification as "vermin" is justifiable. A few analyses of reptile and amphibian stomachs were made, and a report on the Habits and Economic Importance of Alligators (Technical Bulletin 147) was published. The maintenance of reference collections was a special feature of the work, the seed collection in particular being brought up to date and found to comprise more than 5,000 samples of seeds, representing 3,247 species of 1,112 genera.

FIELD INVESTIGATIONS

ECONOMIC ORNITHOLOGY

On the experimental farm of the department in Arlington County, Va., are sample plots of grasses of interest in connection with the maintenance of golf courses. These are used for many experimental purposes, and last spring it was noted that birds were making holes in them, one species, the European starling, sometimes to an objectionable extent. A study of the situation was made, and the results showed definitely that cutworms, which were abundant in the turf, were the principal attraction to the birds. In all probability the cutworms can be greatly reduced or even exterminated by the use of proper insecticides. When this is accomplished, damage by birds undoubtedly will cease. Similar cases have been heard from on golf courses in other sections. The first reaction is to shoot the birds simply to stop the digging of holes; obviously this procedure does not cure the real trouble—damage by destructive insects—which the work of the birds tends to control.

Studies of objectionable starling roosts were made in the District of Columbia, and a case of bird mortality was investigated in which the cause was found to be poisoning operations on the part of persons unknown. A brief publication on English Sparrow Control (Leaflet 61) was published during the year.

The cooperative project of attracting birds to the experimental chestnut orchard of the Bureau of Plant Industry, at Bell, Md., was continued and a further increase achieved in the number of broods produced to the acre. During the four years of the investigation this figure has risen steadily year by year, as follows: 6.8, 16, 18.5, and 25.4. These data apply only to birds occupying houses supplied for them and do not include birds nesting in trees.

Preparatory to a hearing before the Rivers and Harbors Committee of the House of Representatives, an inspection of the Back Bay-Currituck Sound region of Virginia and North Carolina was made in December. This was the eighth trip made to that region by the same investigator for the study of duck-food conditions, besides inspections by other representatives of the bureau. The damage to duck-food plants in that area from salt and sewage contamination coming through the Albemarle and Chesapeake Canal has continued

until vegetation is found to be almost entirely destroyed over about half the entire area of these two bodies of water, a total of about 300 square miles. The diminution in the food supply has had the inevitable result of reducing the numbers of wild fowl visiting the region, and there are not now a hundred wild geese or swans where formerly there were a thousand, and not one duck where there were ten thousand during the time when the food supply for the birds was at its best. The long campaign that has been made for alleviation of this trouble has been crowned with success, as an authorization item for replacing the guard lock in the Albemarle and Chesapeake Canal was included in the rivers and harbors bill passed in the last session of Congress. It is confidently expected that restoration of this lock will result in gradual recovery of the waters from their polluted condition.

Brief studies were made of the condition of wild-duck food plants at three other localities in Virginia, and measures for improvement suggested. In response to complaints that birds were being killed by weed-spraying operations along certain southern railroads, an investigation was made and it was found that little if any damage was being done.

The radio was utilized during the year to broadcast information on the economic status of commonly known birds. Over a nation-wide chain of stations officials of the Biological Survey gave short addresses on how birds help the farmer and on the profit and loss sides of wild life in general. A similar broadcasting of information on the economic status of wild life was given over the same chain of radio stations in a symposium on poisonous pests of campers, the Biological Survey's contribution relating to poisonous snakes. Addresses by radio have resulted in increased demands for publications of the bureau on the subjects thus presented.

FOOD HABITS OF MAMMALS

The relation of rodents and moles to the bulb industry on the Pacific coast has been made the subject of a long-continued investigation, the results of which have been incorporated in a manuscript for a farmers' bulletin. All classes of flowering bulbs commonly grown on the Pacific coast, with the exception of narcissus, are more or less severely damaged, but control measures are found practicable and will be recommended in the bulletin.

The study of the relation of rodents to reforestation in the Pacific Northwest has been continued; and material has been collected to demonstrate the food habits of the hair seal, an animal upon which, because of its alleged destruction of salmon, bounties are being paid. Reports made possible by the examination of this material should throw a clearer light on the economic status of these animals.

There was published, in August, a Farmers' Bulletin (No. 1598), reporting field investigations in the Pacific Northwest and detailing facts in the life history, habits, economic status, and measures recommended for the control of mountain beavers (genus Aplodontia), a group of rodents, formerly unobjectionable economically, that in certain areas has become destructive of crops.

ECONOMIC INVESTIGATIONS OF MIGRATORY BIRDS

DAMAGE BY MIGRATORY BIRDS

Some of the work referred to under the food-habits project, both in the way of established lines of work and of special examinations, related to birds protected by the migratory bird treaty act. It was necessary to give attention to some cases of damage by migratory birds and to recommend slight local alterations in the protected status of a few. The principal work of the year, however, was a continuation of the study of maladies of wild fowl.

To counteract certain unauthorized but widespread claims that swans and crows were so destructive as to warrant general control measures, the bureau issued statements last fall to the press, which were widely published, showing that swans do not destroy unduly the food plants of other waterfowl, including valuable wild ducks; and that the crow problem is for the most part local, by reason of which its proper solution is local and not through campaigns of general extermination. These statements were based upon thorough scientific investigations conducted both at the time, for the purpose of answering the charges made against the birds, and at earlier dates.

DUCK MALADY IN THE WEST

Study of the "alkali sickness" of waterfowl, resumed in June, 1929, was continued throughout the present fiscal year. Field and laboratory work was conducted in southern Oregon and northern California, with laboratory studies and other research work on various aspects of the problem at Washington, D. C. Late in June, 1930, the bureau investigator again left for the West to carry on another summer's field work.

Since 1918, when the Biological Survey published the results of its studies carried on in 1914, 1915, and 1916, alkali sickness has been of frequent recurrence, not only on the marshes adjacent to Great Salt Lake, Utah, where the earlier studies were made, but also at other points in Western States and in certain Canadian Provinces. Points in California, Oregon, Idaho, Montana, Nebraska, North Dakota, South Dakota, Utah, Texas, and the Canadian Provinces of Alberta and Saskatchewan have been the scenes of outbreaks that appear to be similar to the alkali sickness originally studied in Utah. Mortality among waterfowl at a few isolated spots in Arizona, New Mexico, and Kansas also may have been due to the same cause; and even from the State of Durango, Mexico, reports of dying waterfowl have come closely similar to those emanating from our own West.

The great diversity of these areas, especially with respect to the character and degree of salt content of the waters frequented by the sick birds, is one important reason for reopening the study of duck mortality. At some of the localities the entrance of factors other than those found to be causative agents under the highly saline and more or less uniform conditions surrounding Great Salt Lake seemed plausible and even likely. The Klamath region of southern Oregon and the adjacent area about Tule Lake, Calif., were chosen as a field of operations, not only because of the frequent occurrence

of the malady there, but also since the region possesses a variety of bodies of water and marsh areas, some of which are more or less regularly scenes of duck mortality, while others in the same general vicinity are markedly free of the trouble. A laboratory established at Klamath Falls, Oreg., served as a base from which all the places where disease was likely to occur could be reached, and provided facilities for the experimental feeding of healthy birds and for the recovery of sick ones.

The season's field work included the gathering of data on such pertinent factors as changes in water level, temperatures, and precipitation; the collection of water, soil, and encrusted alkali samples from diseased and disease-free areas for subsequent chemical analyses; observations on the growth and subsequent decay of algae in their possible relations to the malady; and a daily watch on the flights, abundance, and feeding habits of healthy birds, as well as the keeping of detailed notes on the number of sick birds encountered in the course of three local outbreaks.

Experimental work involved the feeding to healthy wild ducks of salts in the various concentrations and combinations commonly found in the alkaline waters of the area, with the object of noting reactions thereto and of producing if possible, a condition similar to that brought about by the duck sickness. Other experiments also were conducted along bacteriological lines. Through cooperation with the Bureau of Animal Industry, whereby a specialist was detailed to the laboratory for a part of the summer, the possibility of parasites as causal factors was studied. In all these endeavors the results obtained were essentially negative. Chemical analysis of the waters collected also failed to reveal any constant factor as the causative agent.

During the winter the history of the malady in this country was studied. Experiments also were conducted to disclose the symptoms produced in ducks by certain gases that might have a bearing on the problem, as well as to note the effects of salts not previously experimented with; but thus far the results are either negative or inconclusive.

LEAD POISONING IN LOUISIANA

Late in the winter, investigation was made of mortality among ducks in Vermilion Parish, La. Lead poisoning, a deadly affliction that besets waterfowl in areas that long have been used as hunting grounds, was found to be the cause. Although the extent of the mortality was by no means so great as in former years, the outbreak served again to call attention to the ever-present menace of lead shot deposited on favorite shooting grounds. This shot no doubt persists for many years, buried on mud flats or submerged on lake bottoms. The hapless duck or marsh bird swallowing even a few pellets of shot along with other hard objects taken as grinding material usually is doomed. The poisoning process is a lingering one, death coming after days and even weeks of physical decline.

SURVEYS OF FOOD RESOURCES OF REFUGE AREAS

To complete a reconnaissance of sites proposed for Federal migratory-bird refuges, investigations of their biological fitness

were conducted throughout the vegetative season, and inspection of sites was made in every State of the Union. The total number of projects surveyed from the food-resource standpoint, including about a month's work in the preceding fiscal year, was 189; the total acreage was in excess of 3,700,000. According to their suitability for refuge purposes, these projects were rated as follows: Most highly recommended, 33; less highly recommended, 56; not recommended, 100.

In addition to work on prospective refuge areas, considerable attention was given to the proposed plan for the improvement of navigation on the upper Mississippi, which, if carried out, would vitally affect the Upper Mississippi River Wild Life and Fish Refuge. The Biological Survey was represented at informal conferences on the subject in Washington, and at a formal hearing before the United States Board of Army Engineers in St. Louis. When the possibilities of damage to vegetation on this refuge and consequently to its wild life were pointed out, it was apparent that there was a sincere desire to avoid this, and that in selecting the type of dams to be used in stabilizing water levels, the interests of wild life would be taken into consideration.

COOPERATIVE INVESTIGATIONS IN GAME-BIRD PROPAGATION

The final report on the cooperative quail investigation, the field work for which was completed last year, was prepared, presented to the committee on the investigation, and placed in the hands of a publisher. It will be published for sale only, under the direction of the committee that financed the investigation, and will make a book of more than 600 pages. It will be the most complete account published in the United States of the life history of any game bird and will compare favorably with any that have been produced elsewhere.

The success of the cooperative quail investigation has inspired other similar studies, a number of which are being carried on under fellowship arrangement through cooperation of State universities, the Sporting Arms and Ammunition Manufacturers' Institute, and the Bureau of Biological Survey. The studies already under way are concerned with the Hungarian partridge in Michigan, the bobwhite in Wisconsin, and the ruffed grouse in Minnesota. Arrangements were completed during the year, although the research was not actually begun, for a study of Gambel's quail in the Southwest, with the headquarters of the investigation at the University of Arizona. Cooperation of the Biological Survey in these studies has consisted of assistance in the selection of fellows, in planning and organizing their programs, and assisting with the field work itself for short periods at irregular intervals.

Somewhat similar work included cooperation in planning the program now being undertaken by the New York State Conservation Department for investigation of the ruffed grouse; and inspection of field-trial grounds and other areas in various States, with recommendations for maintaining their maximum population of game birds. A few visits were made to game farms for the purpose of advising as to sanitary and other features of the work and of studying the latest developments in game-bird propagation.

Two farmers' bulletins on rearing game birds were published during the year, one (No. 1612) on Propagation of Aquatic Game Birds, and the other (No. 1613) on Propagation of Upland Game Birds; and to supplement correspondence a mimeographed leaflet (Bi–1064) listing dealers in quail-food plants was issued.

Miscellaneous research in the game-bird field resulted in the publication in November of a circular (No. 96) on foreign game birds suitable for naturalizing in the United States. Both the desirability and the dangers of experimental plantings of exotic species are discussed in the new publication, and an annotated list of species suitable for various regions is presented.

INVESTIGATIONS IN FUR-ANIMAL PROPAGATION

PRODUCTION OF FUR-BEARING ANIMALS

Since the United States is the leading fur-producing as well as fur-consuming country in the world, there has been a constantly increasing demand for scientific information on the conservation, propagation, and utilization of fur animals from interested individuals both in this country and abroad. Extensive studies are being made of all factors involved in the production of fur animals, not only in the wild but under controlled conditions. Cooperative relations have been entered into with the Carnegie Institution of Washington for the purpose of undertaking a comprehensive study of the embryology and physiology of reproduction of the various fur bearers, with the special object of establishing their normal breeding and gestation periods, and other forms of research are carried out in cooperation with the Universities of Minnesota and Southern California. In Alaska the Territorial veterinarian has been appointed as a collaborator of this bureau, and this arrangement will aid in correlating findings on fur animals in that Territory with those resulting from research, experiments, and observations in the States.

The muskrat is recognized as the leading fur producer under natural conditions, and special attention is being given to investigations of this animal in three distinct types of country—the Atlantic coast region, the Gulf coast region, and the inland lake and river districts. It has too frequently been the practice to take muskrats from marshes in a wasteful manner, overtrapping being the rule in many marshes, and operations not being limited to the season when the pelts are of greatest value. One purpose of the research on these animals as directed by the bureau is to determine the time when their pelts reach maximum primeness and the conditions that influence development to this state. Studies on the food and breeding habits of muskrats have been begun, and investigations are in progress with respect to the influence of changes in water levels on the rate of reproduction. It has been found that comparatively few muskrat marshes lend themselves at reasonable expense to a mechanical control of the water by means of dams and canals. Attempts to raise muskrats under closely controlled conditions have been tried by a variety of methods, though with negative results, and it appears that the fur trade must continue to look to the natural marsh areas for muskrat furs. This means increased atten-

tion to the conservation of marshlands. To bring this fact before the public and to present the chief considerations in the conservation and propagation of these valuable fur bearers, a mimeographed leaflet (Bi–1060), Raising Muskrats, was issued during the year.

Investigations indicate that it would be impracticable profitably to raise certain other important fur bearers in small pens under controlled conditions, notably raccoons, beavers, and opossums. Their maintenance will have to depend on a flexible adjustment of hunting and trapping laws, in order that they may not be exterminated or depleted to the point where trapping is not profitable. In another group of fur animals, however, the pelts of which are of somewhat higher value, the species seem to be suitable for pen raising. It seems possible to maintain badgers, fitches, martens, fishers, and minks in captivity under such conditions that ultimately a profit may be made from the sale of skins. Success is dependent upon their attaining a sufficiently high rate of reproduction in captivity. Through the kindness of an individual interested in the experimental work conducted by the bureau, a pair of German fitches were donated to the Biological Survey for investigations on their care, feeding, and breeding habits.

If reasonable protection is given to such fur bearers as live only in the wild, they can be encouraged to utilize extensive areas of otherwise unproductive land. The importance of such protection was stressed in the annual digest of the fur laws of the respective States (Farmers' Bulletin No. 1618).

FUR FARMING

That furs of certain kinds can be produced satisfactorily on farms has been demonstrated by the fact that practically all silver-fox pelts reaching the market are now ranch raised. Though silver foxes are not being produced in the temperate and warmer parts of the United States, it is probable that other fur bearers may be found to be suitable for pen raising in such sections. Breeding stock can now be purchased at prices more nearly commensurate with the actual worth of the animals than heretofore. It is estimated that in this country $50,000,000 is invested in fur farming.

Despite adverse conditions in the fur trade during the past year, fur farming has fully held its own, and many fur farms operating on the pelt basis have shown substantial net earnings. Prices of raw pelts were lower than for several years past, but it is doubtful whether the drop was comparable with that of other raw materials for wearing apparel. Though some fur farms went out of business, many new ones were established and a number of the older ones enlarged.

Just what effect the drop in fur prices will have on the extent of the wild fur take can not be foretold, though possibly protective measures may be more easily enforced. The acquisition by large companies of extensive tracts of land supporting many fur animals for the purpose of commercial trapping also is aiding in conservation measures, since owners of such areas have large sums of money invested and naturally are anxious to lend every aid in improving their holdings.

DISEASES OF FUR ANIMALS

Studies of diseases of fur animals have been continued in cooperation with the University of Minnesota, at the university as well as on fur farms where outbreaks have occurred. Attempts made under practical ranch conditions to immunize foxes by means of serums against some of the more commonly encountered diseases have met with a fair degree of success. Before such products can be offered to the public for general use, however, the tests must be carried further and a greater certainty of protection against disease developed.

Besides the more commonly encountered maladies—fox paratyphoid and epizootic fox encephalitis—on a number of fox farms other sporadic infectious diseases have made their appearance. Though these have not as yet received complete study, it has been ascertained definitely that epizootic fox encephalitis and dog distemper are distinct diseases.

A motion-picture film was released in July, 1929, depicting the symptoms and pathology of fox encephalitis. This film was made at intervals during the past two years in cooperation with the University of Minnesota at fox farms and elsewhere when the disease made its appearance. It will be of special value to conventions of veterinarians and fox breeders.

To learn ways of preventing losses from diseases in rabbitries, and to study their cause and methods of control, a cooperative working agreement was entered into in August, 1929, between this bureau and the University of Southern California.

FUR-ANIMAL EXPERIMENT STATION

The major activity at the fur-animal experiment station, maintained by the Bureau of Biological Survey at Saratoga Springs, N. Y., is investigations on silver and cross foxes, and during the year several pairs of badgers and martens also have been under observation there. The process of discovering new facts affecting the crossing of various strains of silver and red foxes is exceedingly slow. Inadequacy of facilities, including lack of a sufficient number of breeding animals, has retarded these studies. Along with the breeding experiments, extended tests in the control of parasites of fur animals have been carried on, as well as a study of the problems of general hygiene. A mimeographed leaflet (Bi–1053), Ear Mange in Foxes: Its Treatment and Eradication, was issued, and a printed leaflet (No. 47), Hygiene in Fox Farming, was published during the year for the guidance of fox farmers. Of special interest to those striving for economical production of foxes for fur is a mimeographed leaflet (Bi–990), A Comparison of Feed Costs with Pelt Values of Silver Foxes, which has been issued recently in revised form.

Knowledge of the care and breeding habits of badgers is as yet incomplete, but for the purpose of supplying the available information to the many inquirers on the subject a mimeographed leaflet (Bi–1059), Raising Badgers in Captivity, was issued during the year.

The birth of a litter of four martens in April confirms the findings of previous years on the gestation period in this species. A résumé

of the knowledge gained at the fur-animal experiment station on the reproduction of these animals, as well as of observations by other investigators, has been made available in a circular (No. 107), entitled "The Normal Breeding Season and Gestation Period of Martens."

In cooperation with the American Fox Breeders' Association and the New York State Fox Breeders' Association, the third day of their convention and summer school in September was given over to a visit to the fur-animal experiment station, where field-day exercises were held. Representatives of the department explained the purposes and work of the station, and during a tour of inspection the visitors had full opportunity to gain first-hand information about breeding experiments with red foxes, purebred silver foxes, martens, and other fur bearers, construction of pens and other fixtures, the use of instruments in treatment of diseased animals, and feeding experiments. The station is kept open to the public on Wednesdays and Sundays from June 1 to December 1, between the hours of 10 and 4.

RABBIT EXPERIMENT STATION

The main purpose of the rabbit experiment station, maintained by the bureau at Fontana, Calif., is to investigate improved methods suggested for raising domestic rabbits for food and fur. Changing conditions in this rapidly developing industry require an increased series of experimental tests on the nutrition, housing, and breeding of rabbits. Feeding studies are being made with a wide variety of suitable foods native to various parts of the country. Information thus far developed is contained in a recently issued mimeographed leaflet (Bi–1066), Suggestions for Beginners in Rabbit Raising. This leaflet likewise presents other important information for prospective investors in the rabbit-raising industry. A full description of the new station, its equipment, and methods of research was published in the 1930 Yearbook of Agriculture.

One of the prime essentials to making rabbit raising successful is the development of a market for the meat, the sale of which provides the principal source of income for the average commercial rabbitry. The Bureau of Home Economics, with the cooperation of the Bureau of Biological Survey, had in press at the close of the year a leaflet (No. 66), entitled "Rabbit Recipes," prepared to give helpful suggestions to consumers on the best methods of preparing this commodity for the table.

The matter of construction of suitable buildings and hutches for rabbits in diverse parts of the country is receiving considerable attention. A leaflet (No. 15), Rabbit-House Construction, has been revised to suit modern demands, in cooperation with the Bureau of Public Roads. One function of the experiment station is to develop a type of hutch construction that will minimize the work of caring for stock and be of such design that sanitation will be maintained easily. The latest findings are presented in the revised leaflet.

In addition to its general dissemination of information on rabbit production in bulletins, leaflets, and radio addresses, the bureau has utilized the exhibit method on occasion during the year for depicting rabbit raising at fairs and conventions in Western and Southwestern States, the region where the industry is at present most flourishing.

INTERNATIONAL FUR-TRADE EXPOSITION

By special congressional authorization it has been made possible for the United States Government to participate in the International Fur Trade Exposition and Congress held in Leipzig, Germany, from June 1 to September 30, 1930. Frank G. Ashbrook, in charge of the division of fur resources of this bureau, was appointed commissioner general to represent the United States. An exhibit representing various phases of the fur industry in the United States was prepared in the office of exhibits of this department. The information and material were furnished in cooperation with this bureau and the Bureaus of Fisheries and of Foreign and Domestic Commerce of the Department of Commerce. The purpose of the exhibit is to depict all aspects of the fur industry in this country so that interested individuals and organizations from other countries may be better informed with respect to the sources of the supply of furs as well as on the nature and extent of the commercial manufacture of raw furs into finished wearing apparel as conducted in the United States.

The exhibits display fur animals native to this country in their natural habitat, as well as scenes and operations on fur farms, and these are supplemented by motion pictures, lantern slides, transparencies, and charts, together with a special bulletin in English and German editions, discussing all phases of the fur industry. Visitors from foreign countries to this exhibit were encouraged to cooperate with this country in measures for the conservation and production of furs and fur animals, and for such utilization as the condition of the native stocks warrants.

RESEARCH IN CONTROL METHODS

To control the various species of vertebrate animal pests calls for a broad program of investigation so that field workers may apply up-to-date methods that provide essential safeguards. Such predatory animals as coyotes, wolves, bobcats, and mountain lions, and an occasional stock-killing bear, cause heavy monetary losses in livestock and destroy much valuable game every year. Prairie dogs, ground squirrels, rabbits, porcupines, woodchucks, rats, mice, or other rodents destructive to forage, growing crops, stored hay, and foodstuffs are found in all parts of the United States. Occasionally, also, gregarious species of birds become economically injurious—notably, in some localities, crows, magpies, and starlings. Research work in methods of control is conducted in a laboratory of the Biological Survey at Denver, Colo., and in field tests by a staff of technical men working in conjunction with control operators, and in the case of most birds, by economic ornithologists detailed from the Washington office.

During the past year the field laboratory was called upon to develop a means of combating the difficulty that had been experienced in the West in controlling the activities of rodents, including rabbits, ground squirrels, and prairie dogs, which in some localities were feeding on native plants that had a tannic-acid content sufficiently high to counteract the effect of ingested strychnine. Control operations at certain times of the year were thus made extremely difficult.

In other cases changes in control methods had to be worked out on rodent-infested lands that had been treated for several years with strychnine-coated grains, where the survivors had developed a distaste for them and something of an immunity to their usual action.

The bureau is constantly striving to develop methods that will prove more effective against predators and rodents and at the same time be less harmful to other forms of wild life. Though the gallinaceous group of birds, such as quail, grouse, and domestic chickens, are practically immune to the usual effect of strychnine, other forms of bird life are susceptible. It has been demonstrated, however, that grain baits may be efficiently prepared from large-kerneled, steam-crushed oats that have been cleaned thoroughly to eliminate the weed seeds and the small cracked kernels so attractive to birds. The preparation and distribution of such baits by the Biological Survey represent a great improvement over the methods previously employed by private landowners, and these are far superior in effect to the commercial poisons used with wheat and other small grains, or bait intermixed with small seeds, particularly as the commercial products often carry phosphorus, arsenic, and other poisons dangerous to bird life.

An example of the value of the control-methods laboratory was furnished near Denver, Colo., a short time ago. Local telephone officials had asked for assistance in devising methods for controlling crows over a stretch of country traversed by their lines. These birds were building their nests in the wires as well as on top of the poles, and were using as a base pieces of scrap wire picked up in the surrounding country. This caused short circuits in the telephone lines and necessitated the employment of a number of men to keep the wires free from interference. Investigation and experiment at the research laboratory developed a bait acceptable to the crows, and in a short time this disposed of the birds frequenting the line. The telephone company's expenses for line service were reduced thereby from $36 to $6 a day, and the estimate of total savings since the control methods were applied was $1,250.

During the year a Technical Bulletin (No. 134), entitled "Red-Squill Powders as Raticides," was published, and a manuscript prepared on the same subject for popular publication in the leaflet series. Porcupine Control in the Western States, a leaflet (No. 60) giving information on the control of this rodent destructive to trees, was also published following research work, and a report was practically completed on the chemical and physical properties of thallium for use in rodent baits. In the 1930 Yearbook of Agriculture, under the title Rodent Control Aided by Mixing Bait at Cooperative Stations, a full description was given of methods followed at the station maintained by the Biological Survey at McCammon, Idaho, to insure that cooperating control workers shall be provided with a uniformly toxic bait prepared in accordance with methods developed by control research workers.

COOPERATION IN WILD-LIFE CONTROL

EXTENT OF COOPERATION

The Biological Survey has not been able to meet all the demands for assistance that have come from States where predatory animals

levy their annual toll on the livestock interests. In addition to killing sheep, calves, pigs, and poultry the predators are also a great menace to wild birds and to such game mammals as deer and elk. Prairie dogs, ground squirrels, and jack rabbits cause large annual losses in the Western States, but these do not compare in monetary terms with those sustained east of the Mississippi River through depredations of house rats; in some areas pine mice and pocket gophers are exceedingly destructive also. In consequence the demand for assistance in rodent control has become nation-wide. Although it has not been possible for the Biological Survey to render direct assistance in response to all requests received, no request has gone without attention. Wherever possible personal assistance has been given, but where this could not be done information was furnished suggesting measures of control.

The services of the Biological Survey have consistently been based upon cooperative agreements with livestock, agricultural, or conservation organizations in the States where its representatives have been stationed. As an indication of the general spirit of cooperation between the bureau and other agencies interested in this line of work it may be noted that $1,528,565 was made available during the past fiscal year by States, counties, agricultural organizations, and individuals to help carry on the control campaigns in cooperation with the Biological Survey.

Closer cooperation with the Bureau of Indian Affairs of the Department of the Interior and a better understanding between field forces of the two bureaus have resulted from a cooperative agreement now in effect. This agreement specifies that the supervision of all needed predatory-animal and rodent control operations on Indian reservations shall be furnished by the Biological Survey, with the Indian Bureau supplying its proportional share of equipment and help. It will facilitate control operations on many of the Indian reservations in the West.

Federal and cooperative funds available during the year permitted organized field work in the control of predatory animals and injurious rodents in 36 States. Federal funds available totaled $569,594, of which $34,834 was used in research at the Denver laboratory; $325,974 in the control of predatory animals; and $208,786 in the control of rodents. The States provided $495,441 to use in the bureau's control operations, while counties, livestock associations, and individuals furnished $1,033,124; thus, the total made available by cooperators was $1,528,565 for conducting the organized control campaigns.

THE 10-YEAR CONTROL PROGRAM

From the time of its inception, the Bureau of Biological Survey has been making investigations of the various forms of wild animals inimical to agriculture, horticulture, forestry, livestock, and game. One of its earliest publications, Circular No. 3, issued in 1886, dealt with the economic relations of mammals. Investigations have continued to the present time, and are still being conducted, on the relations of predatory animals to livestock and game; of rodents to agriculture, horticulture, and forestry; and of predatory animals to rodents.

The damage inflicted by predatory animals and rodents to livestock and crops, and previous outbreaks of rabies, had led Congress to authorize in the appropriation act of June 30, 1914, for the fiscal year 1915, "experiments and demonstrations in destroying wolves, prairie dogs, and other animals injurious to agriculture and animal husbandry," though demonstrational work in the control of injurious rodents, chiefly on public lands, had been undertaken several years previous. An impetus was given control operations by an emergency appropriation in 1916 of $75,000 for the suppression of rabies in wild animals, chiefly coyotes. The difficult task of building up an organization and developing methods of control was given the Biological Survey. Since that time, appropriations have materially increased, but cooperative funds have grown in even greater degree, until States, counties, organizations, and individuals now contribute three times as much money for expenditure under the direction of the Biological Survey as does the Federal Government.

The success thus far attained with the limited resources indicates the even greater accomplishments that might be expected if the bureau were fully equipped to carry out an adequate control program. Congress gave this matter consideration, and as a proviso to the act making appropriations for the department for the fiscal year ended June 30, 1929, called for an investigation as to the feasibility of a cooperative program for the control of these wild-animal pests, extending over five or more years. This investigation was made, and a report thereon recommending a 10-year program was submitted to Congress.

In the recent session of Congress bills were introduced in both Houses to authorize the institution of this 10-year control program. The proposal was approved by the Bureau of the Budget in March, and hearings before the House Committee on Agriculture were held a month later. Strong indorsement of the measure was given by many national, State, and local organizations, including State legislatures, State agricultural commissions, farm bureau federations, cattle, sheep, goat, and poultry raisers' associations, horticultural societies, associations of the fur industry, sportsmen's organizations, State fish and game departments, chambers of commerce, and others, though some objection was made by naturalists, individually and through their organizations, who feared threatened extermination of certain predatory animals and opposed some of the control methods employed.

It has previously been pointed out that the program of the organized cooperative campaigns has been from the start one of local suppression rather than complete eradication of species. Such control operations as are recommended or undertaken are in the interests of man and his economic welfare, and, though necessary, the thought of destroying interesting wild animals is as abhorrent to those directing the work as to the many other lovers of wild life throughout the country. It is a task, however, that calls for use of the most efficient methods that can be devised. Before the close of the year plans were laid for undertaking additional investigations in the food-habits research laboratory of the bureau in Washington of the food of the various larger mammals, especially of the coyote. These studies will supplement the large existing record of stomach examinations in the field and other records already available in the bureau. Tentative

plans were made also for establishing at an early date a field laboratory at some central point in the West.

Recent opposition by a group of naturalists to the control operations of the bureau has been based on the assumption that insufficient preliminary research has been undertaken and that inadequate safeguards were being thrown about the use of poison for predatory animals in localities where fur animals might be endangered. Augmentation of the research program should have the effect of giving full and satisfactory answer to such criticisms. To make fully evident, however, the nature of the field operations and their possible effect on species other than those for which control is intended, arrangements are being made to have trained naturalists of the bureau assigned during the coming year to cover typical poison and trap lines in the West in conjunction with the local operatives of the bureau. Furthermore, invitation has been extended to representatives of zoological societies and scientific institutions to accompany bureau naturalists on these check-up and investigational trips, to observe the methods employed and to suggest corrective practices where these are deemed necessary.

CONTROL OF PREDATORY ANIMALS

Predatory-animal control operations were conducted during the year in portions of all States from Montana to Texas and westward to the Pacific coast, and also in South Dakota and in parts of Oklahoma and Arkansas. In addition, cooperative work was entered into late in the year in Minnesota, Wisconsin, and Michigan at the request of the respective State game and fish commissions, and three experts in predatory-animal control were detailed as leaders of the work in these States.

Requests for assistance were received also from North Dakota, Iowa, Kansas, Illinois, Indiana, Missouri, and Nebraska, but funds did not permit extending field assistance in these areas with the exception of a few months' work in coyote control on the Nebraska National Forest in the interest of game protection. These States contain enormous breeding areas for such predators as bobcats, coyotes, and wolves.

In cooperation with and at the request of the Virginia Commission of Game and Inland Fisheries, a trained predatory-animal hunter was detailed from Wyoming to parts of Virginia, where six months' work was undertaken in the control of bobcats, for the protection of deer. Previous field observations had been made by two biologists of the bureau, who found these valuable game mammals to be suffering from bobcat depredations.

Cooperative work for the control of wolves and coyotes continued in Alaska, chiefly with the object of training local trappers. Field surveys on the islands of Wrangell, Etolin, Brownson, and Deer revealed the presence of wolves and showed that a great many deer had been killed recently by these predators.

As in previous years control operations in general included trapping, poisoning, and den hunting, with occasional hunting with trained dogs. In many States where control work was undertaken no poison was used. In fact the only States in which poisoning operations were conducted were in the Rocky Mountain and Great

Basin regions, in parts of the Pacific Coast States, and in the western parts of South Dakota and Texas. In addition, no work of control of any nature was done by the Biological Survey in any of the national parks.

In the control operations conducted by the Biological Survey, a year-long average of only 505 Federal, State, and cooperative hunters were employed, and many of these used no poison. These men engaged in work over the whole area of the States in which predatory-animal control was carried on, a very limited region compared with the total range of the predators over western stock country and on the public domain, including national forests and parks. Furthermore, information gathered throughout the West indicates that there are at least 8,000 men not connected in any way with the Government, a large number of whom are professional trappers, engaged in poisoning predatory animals. Compared with the total number thus working with poisons, the representation of the Biological Survey is limited, indeed. Moreover, it is highly significant that the Government employees are responsible men, working under competent direction, and that all possible safeguards are thrown about their operations for the protection of harmless and valuable species of wild life.

The bureau has a definitely established policy regarding safeguards in the use of poisons, and if a supervisory officer ascertains that his instructions to a field worker are not implicitly followed, he is authorized and directed to take prompt disciplinary action. It is highly desirable, in the interest of wild-life conservation generally, that control measures be under competent direction. It should be a source of general gratification, especially to naturalists and other scientific men, that operations by the Government for the control of injurious wild animals are conducted by biologists and other field agents of a bureau that is recognized for its interest in the conservation of the wild-life resources of the Nation, rather than by men whose dominant interest is merely increased economic production.

WOLVES AND COYOTES

Field observations by the Biological Survey over more than 25 years warrant the assertion that the coyote is the most destructive natural enemy of livestock and wild life in the western country. Though at certain times of the year it obtains a goodly portion of its diet from injurious rodents, it must be conceded that the coyote alone can not be relied upon to keep them in check. This fact becomes evident when it is considered that rodent plagues occurred long before any material reduction of the coyote population was brought about by advancing civilization, and that unusual outbreaks of rodents are still noted in areas where coyotes occur in large numbers. Again, many cases have been noted where coyotes inhabiting rodent-infested areas have raided sheep bands, pigs, poultry, or wild life. Such raids are general throughout the coyote range where rodents and farming, stockraising, and game interests are closely associated. Nor has the coyote served to stop the prairie dog in its gradual and effective infestation of the national forests and of large areas of the

public domain. This holds true likewise with respect to its relations to the jack rabbit, the pocket gopher, and the ground squirrel.

Sporadic outbreaks of rabies among coyotes occurred during the year in Nevada, Oregon, California, Utah, and Washington. To cope with the situation in Washington, $1,500 was obtained from the Secretary's reserve, and three hunters have been kept continually in this section since the first rabid coyote was killed in September. In Oregon the outbreak occurred among dogs and coyotes during January and February, and approximately 60 head of cattle died from the disease. To curb coyote infestation, bureau hunters were placed in the field in cooperation with the Harney County Court and the Oregon State Live Stock Sanitary Board, and an additional $500 was released by the Secretary from his reserve. All dogs were quarantined and vaccinated, and dogs running at large were either vaccinated or killed. The outbreak of rabies in Utah occurred during the winter, and its spread to adjacent sections was prevented by cooperation on the part of the bureau with the State boards of agriculture and of health.

In the past few years coyotes in Colorado have been reported as turning more and more to the killing of young calves. A Hereford breeder in this State, who keeps all purebred cattle under fence, last year lost 12 calves and a yearling from coyotes. The destruction of 72 coyotes on this range stopped all losses.

The number of coyotes killed during the year, as revealed by skins and scalps recovered, exceeded that of the previous year. By far the greater part were removed from livestock ranges and farm sections. Because of the possible danger to fur animals no intensive work, and in many cases no work at all, was done in breeding areas of coyotes where martens, fishers, foxes, skunks, and other important fur bearers were in evidence.

Gray and red wolves still commit depredations in Texas, Oklahoma, Arkansas, Wisconsin, Minnesota, and Michigan, and a field survey showed their prevalence in northern Louisiana. The gray wolf also is constantly crossing the Mexican border into Arizona and New Mexico. Operations for the control of gray and red wolves were most extensive in Texas, Oklahoma, and Arkansas, the work in the Lake States not getting under way until near the close of the fiscal year.

To meet the many requests for information on trapping emanating from private trappers, game conservationists, stockmen, and farmers, a leaflet entitled "Hints on Coyote and Wolf Trapping" was prepared and was in press at the close of the year. It will be especially useful in supplying information when direct personal aid can not be rendered.

MOUNTAIN LIONS

Operations by the Biological Survey in cooperation with the various States were undertaken for mountain-lion control on stock and game ranges in parts of Oregon, New Mexico, Colorado, Montana, Washington, Utah, Texas, Idaho, Nevada, and California. Trained dogs as well as traps were used and these measures resulted in satisfactory control of depredations.

BEARS

Each year increasing requests are made upon the bureau for the removal of alleged stock-killing bears. As stated repeatedly, it is the policy of the Biological Survey to establish the fact that bears are responsible for stock-killing that has been reported before the bureau will authorize measures for their control. The degree of caution exercised by field workers of the bureau in determining the facts frequently leads to criticism from cattle growers, the opinion often being voiced that the bureau should take more prompt action for the removal of bears from the stock ranges. The protection of innocent bears in such cases is not a simple matter. Nevertheless, the policy as stated is being rigidly adhered to.

BOBCATS AND CANADA LYNXES

Increasing numbers of requests for information regarding bobcat control have come from the Eastern States. A forthcoming leaflet of the department will give essential information showing that the bobcat feeds, to a large extent, upon rabbits and other rodents, but at the same time that it can be and often is exceedingly destructive to young lambs, goats, antelope, pigs, calves, and poultry, and preys upon deer, especially fawns, and wild turkeys, quail, and other ground-nesting birds. Sheep are more often attacked at lambing time on open ranges that are in close proximity to the broken, rough, and rocky canyon country that forms the regular habitat of this predator. Depredations on livestock by the Canada lynx in no way approach those occasioned by the bobcat, though at times they are responsible for losses among young lambs, particularly on the higher spring lambing ranges. Work for the control of these predators has been carried on in many localities throughout the year so far as was possible and necessary.

HOUSE CATS

In last year's report mention was made of increasing depredations by house cats that revert to wild habits, often because of neglect and abandonment by their owners. A leaflet (No. 50) presenting directions for taking and disposing of vagrant cats was published during the year under the title "How to Make a Cat Trap." Many requests have been made for this leaflet, more than 18,000 copies being distributed between November and the end of June. The testimony that house cats, when they revert to the wild state, are the most destructive agent to bird life is piling up year by year, and the time is not far distant when conservationists and game administrators will demand the institution of such control measures as will greatly reduce their abundance.

BOUNTY FRAUDS

Through the agency of a predatory-animal hunter of the bureau working during the year in the State of Washington, the operations of thieves illegally collecting bounties on bobcats were broken up. Several counties of the State were paying bounties of $5 on bobcats, and the large numbers of skins being presented for the payments led one county official to make inquiries of the Biological Survey hunter.

whose ordinary catch, it was disclosed, was not more than 4 or 5 in three seasons. A check-up at once followed on a claim presented on 34 bobcats, the claimant stating on affidavit that the animals had been taken in the immediate vicinity within the past 30 days. Further investigation resulted in arrests, and it was developed that this claimant had already collected $645 in bounties on 129 "bobcats," most of which were ocelots, small animals of the Southwest, and southern wildcats, also taken outside the State. Other evidences of similar fraudulent bounty claims in the State were soon disclosed, the irregular claimant in one case proving to be a man who had been strongly condemning the paid-hunter system of the Federal Government.

Similar bounty frauds in Kansas reported during this year, in connection with coyote control, involved payments of bounties by the State over a period of 18 years aggregating, it was estimated, $180,000. Arrest of four dishonest hunters, who had been operating over 80 counties, broke up the nefarious business, the men receiving penitentiary sentences.

These are particularly pernicious examples of the operations of the bounty system, and show how it may lead to the extensive destruction of wild animals other than those for which control measures are designed. In the sections of the country mentioned, at least, the arrest of the dishonest bounty hunters gave general demonstration of some of the serious disadvantages of the bounty system as compared with predatory-animal control by responsible salaried workers.

CONTROL OF INJURIOUS RODENTS

One Biological Survey investigator has ascertained that 385 ground squirrels consume as much forage as will one cow. Another reports that 14 jack rabbits eat as much dry feed as a sheep, and 71 of them as much as a cow. These destructive rodents infest western range lands literally by the millions, taking forage that now should be available to valuable cattle and sheep. Farmers in areas heavily infested with ground squirrels, prairie dogs, and jack rabbits find it absolutely essential to control these pests if crops are to be grown profitably. That damage to crops and forage is not the only charge against these rodents was exemplified in stockmen's reports that pocket gophers and other rodents in Arizona during July and August last year burrowed through the embankments of reservoirs and when the rains came and filled them the dams washed out, necessitating repairs costing $80,000. Field operations of the Biological Survey have shown that effective control of rodents can be accomplished only by thorough-going cooperation of all landowners, and by systematic and simultaneous treatment of large areas. The bureau has developed poison formulas, methods of distributing baits, and a trained personnel to assist landowners in these campaigns. Such organization has resulted in the control of rodent pests on millions of acres of valuable agricultural and grazing lands and has been attended by large direct savings and increased production of important crops. In years of severe drought like the present it is especially important to lessen the competition of rodents with livestock for the limited range forage produced.

Organized rodent-control operations (including demonstrations in combating moles) have been carried on in 27 States, and educational work in 5. In addition to furnishing expert advice and leadership in organizing and conducting control campaigns, the Biological Survey is given the responsibility of rodent control on vast areas of public domain in the West. Such lands must be treated systematically if lasting results are to be obtained, both on these lands and on adjacent areas.

GROUND SQUIRRELS

Ground squirrels of various species are generally distributed over the States west of the Mississippi River and are found also in Wisconsin, Illinois, Michigan, and Indiana. Their damage is not limited to the destruction of crops and forage, but includes also serious injury to irrigation ditches, caused by their burrowing through the banks and allowing the water to escape. In some sections of the West, farmers and ranchers find it impossible to raise crops of any kind without undertaking some measure of ground-squirrel control. These rodents heavily infest mountain valleys, and in such districts all lands—State, Federal, and private—must be treated in a systematic manner, with follow-up work to prevent later reinfestation.

The effectiveness of systematically organized operations against ground squirrels is exemplified in the Star Valley, western Wyoming, which is completely surrounded by squirrel-infested mountains. Here a unit of valuable farming land was cleared of ground squirrels four years ago by a crew under Biological Survey supervision. The squirrels are now being kept from this valley by a small crew working on the outskirts each year. Last year an area of more than 60,000 acres was treated at a cost of 1 cent an acre. No loss is being suffered at the present time, whereas five years ago, before the present system of defense was adopted, the loss was reported to exceed $25,000 a year.

PRAIRIE DOGS

Prairie dogs live in large colonies or towns, usually in the finest grazing areas, in the Plains States and westward to the foothills of the Rocky Mountains, as well as in Utah, New Mexico, Colorado, and Arizona. In many cases after control operations have been satisfactorily conducted native grasses can be cut as wild hay. In Colorado, on one national-forest allotment, the grazing capacity of the range was increased from 250 head of cattle in 1925 to 500 head in 1929, largely as a result of the work of paid crews supervised by representatives of the Biological Survey. The forest supervisor in charge of this district considers that the control of the prairie dog on this specific unit has been largely responsible for doubling the carrying capacity of the range in the 4-year period.

JACK RABBITS

Jack rabbits, which inhabit practically all the territory west of the Mississippi River, are responsible for large losses in farm crops and range grasses, and in many localities also in hay and grain in stacks. In previous years they were a serious menace in many localities, but

during the past year their numbers were greatly reduced, until at the present time their damage is slight. Extensive control operations against jack rabbits by the Biological Survey and its cooperators, the high price paid for skins by fur companies, and a disease that made serious inroads on their numbers were found to be responsible for this decrease. Jack rabbits are carriers of tularemia, a disease that not only causes the death of many rabbits and other rodents but is also transmissible to man. The bureau demonstrated the market value of rabbit skins in exhibits at fairs in Arizona during the year.

POCKET GOPHERS

The need for pocket-gopher control is very generally recognized, both in Western and Eastern States. Where measures of suppression are not taken the animals damage growing crops, shrubs, and fruit trees, and cover and destroy vegetation by the mounds they throw to the surface, and at harvest time the piles of earth interfere with mowing machinery. These rodents also are a decided factor in erosion and soil loss in many areas, particularly in the Western States. In some mountain parks pocket gophers have become so numerous as practically to destroy all vegetation. The loss they occasion in burrowing through irrigation ditch banks and reservoirs, including the resultant flooding, is very great; one Texas nurseryman, for example, reported during the year that 70,000 citrus cuttings and $2,500 worth of nursery stock were destroyed in this way by pocket gophers before the damage was stopped by representatives of the Biological Survey. Many calls have been made for assistance also in eliminating pocket gophers from airport fields, their mounds constituting a serious hazard to the safe landing of airplanes.

WOODCHUCKS

Woodchucks are not usually a serious farm pest, as they frequent rocky areas, woodlands, and thickets. At times, however, they may become destructive in fields adjacent to such places. Damage by woodchucks has been of increasing importance of late years in some of the Eastern States, and demonstrations have been made and information has been distributed by the bureau instructing landowners in methods of control. A motion-picture film to assist in disseminating information regarding control chiefly in the Eastern States was released during the year.

PORCUPINES

In their choice of food, porcupines are not fastidious, but consume succulent plants of many species and the buds, leaves, and inner bark and cambium of numerous kinds of trees. During the summer they generally feed upon juicy ground vegetation. In the West in fall and winter, however, their diet consists largely of bark and leaves of coniferous trees, especially the western yellow pine and several species of juniper. Because of these feeding habits the damage to cultivated crops caused by porcupines occurs chiefly during spring and summer and includes the destruction of young fruit trees, the defoliation of mature ones, and the destruction of alfalfa and truck

crops upon which they feed. During the fall and winter the most serious damage from an economic standpoint is caused by their injuring or killing young forest trees. At this time of year porcupines in their efforts to get at the inner layer of bark often partly or completely girdle the main leaders or boles of trees. Many small seedlings (up to 5 years of age) are completely destroyed, while the larger ones frequently suffer injury serious enough to cause death, but more often this injury results in a weakened bushy topped or spike-top tree useless for commercial purposes. In areas of heavy infestation 10 to 100 per cent of the young growth is frequently so damaged as seriously to interfere with any successful program of reforestation and forest management.

The control of the porcupine has been stimulated during the year by reason of the increasing numbers of these animals throughout their range in the Western States, and the development of efficient control methods has been called for. Control measures of a rather simple nature have been worked out by the investigators of the bureau, and these have been used to excellent advantage in the forests of several of the Western States where porcupine damage was excessive. A leaflet (No. 60) describing methods of control was issued.

BROWN RATS

The brown rat, introduced from the Old World into America and now present in every State of the Union and in Alaska, is the most destructive of wild-animal pests. The thickly settled Eastern States suffer more from its work than do the areas farther west. Control measures are exceedingly difficult when an abundant food supply and ready shelter are available for it. Crops and forage, stored grains, and foodstuffs are among the products it wastes, and it is also a carrier of the dread bubonic plague and other diseases of man. With such an indictment against it, unrelenting measures to lessen its numbers are demanded.

Organized rat-control campaigns, directed by field leaders of the bureau, have been carried on in practically every State east of the Mississippi River, and in South Dakota, Colorado, Montana, Washington, Texas, Oregon, and Utah. In the East 128 campaigns were conducted, mostly in towns of 2,000 to 50,000 population, though an increasing number were held on the county-wide basis. Work was supervised on 50,700 separate premises, at a total cost to cooperators of $17,545, or an average of 35 cents for each piece of property. A check-up of results indicates that about 75 per cent of the premises treated were entirely freed of rats.

Up to 1928 the chief poison used in rat-control operations was barium carbonate, but in that year Biological Survey investigators developed methods employing powdered red squill for the purpose. This has proved to be a most effective raticide, has the advantage of being specific for rats and mice, and its sale by commercial manufacturers has increased to more than 125,000 pounds annually. Additional information on rat control was presented during the year in connection with special exhibits at fairs in Texas.

Farmers' Bulletin No. 1533 on rat control was revised and reissued during the year, and is among the publications of the department in greatest demand by the public in all sections of the country. This

will soon be supplemented by an additional publication on rat-proofing methods prepared during the year in cooperation with the Bureau of Public Roads.

FIELD MICE

Outbreaks of field mice occurred during the year in South Dakota and Oregon, the damage to wheat fields over some 5,000 acres in South Dakota alone amounting to more than 2 bushels to the acre, at a time when the grain was selling at 98 cents a bushel. Prompt control methods by bureau representatives in the State stopped the mouse plague, and no serious difficulty has been experienced there since.

In orchards mice using weeds and grass as cover frequently burrow about the roots of trees and eat the bark and cambium layer, girdling and causing the death of the trees. Such damage is of common occurrence every year throughout the Middle Western and Eastern States. The Biological Survey has actively assisted eastern orchardists in the control of field mice this year, the work having the effect of protecting more than a million fruit trees, at a cost of approximately half a cent a tree. General aid in mouse control was given by the issuance in revised form of Farmers' Bulletin No. 1397 on Mouse Control in Field and Orchard.

CONTROL OF MOLES

Moles are very troublesome in lawns and gardens in the Pacific coast region and in the eastern portion of the United States, but their principal damage is in bulb-raising sections of the west coast. As their food consists of insects, it is more difficult to poison them than pocket gophers and other burrowing rodents. The experimental force of the Biological Survey, however, has been working on control methods during the year that promise satisfactory results.

ACQUISITION OF WILD-LIFE REFUGE AREAS

FEDERAL AND STATE ENABLING ACTS

The migratory bird conservation act of February 18, 1929, became effective on July 1 of that year, when the funds necessary for carrying out the migratory-bird refuge program became available. This most important legislation was the culmination of years of activity on the part of wild-life conservationists for the establishment of sanctuaries for ducks, geese, and other migratory game birds throughout the United States. Its passage and administration mark further steps in this country's efforts to carry out its treaty obligations with Great Britain for the protection of the birds that twice each year, in spring and fall, migrate between the United States and Canada.

The responsibility of selecting and negotiating for the areas that will contribute so materially to the preservation of our wild fowl lies with the Bureau of Biological Survey, and in planning judicious expenditure of the funds appropriated and authorized by the act, aggregating approximately $8,000,000 over a period of 10 years, the

extensive knowledge and voluminous data in the possession of the Biological Survey have been fully utilized.

The migratory bird conservation act embodies a clause requiring the consent of the States to the acquisition of lands therein by the United States before the Federal Government can make purchases. Requisite action has already been taken in all but the following 17:

Alabama	New Hampshire	Texas
Arkansas	New Jersey	Utah
Delaware	North Dakota	Vermont
Idaho	Oregon	Washington
Indiana	Pennsylvania	Wisconsin
Massachusetts	Tennessee	

It is trusted that many if not all of these States will take appropriate action at the next sessions of the legislatures.

Early in the year a pamphlet was issued (Bi–1018) describing the procedure to be followed by persons having lands suitable for refuge purposes to dispose of; and in the 1930 Yearbook of Agriculture, under the title "Migratory-bird Refuges to be Increased under New Conservation Act," a popular explanation was made of the necessity for establishing the refuges, the steps leading to the passage of the new law, and the measures to be followed in the acquisition and administration of suitable areas.

PROGRESS IN LAND EXAMINATIONS

Under the $75,000 made available on July 1, 1929, investigational work was instituted, as already mentioned, on the wild-fowl food resources, existing and potential, of areas recommended. In addition, to determine accurately the types of land, the uses intended, and the character, extent, and value of existing improvements, intensive examinations were made of the lands embraced by desired units. Ownership data also have been gathered, valuation studies made, and records and maps compiled. At the end of the year this work had been conducted in 24 States, covering 40 units over a total of approximately 1,225,000 acres of land and water.

As a result of studies made, 2 areas of Federal lands have been withdrawn by Executive order for reservation for bird-refuge purposes, and investigations with a similar end in view are in progress on 5 others. Since the first of April, negotiations have been conducted for the purchase of 8 refuge sites, for 2 of which purchase agreements have been reached, and approval of the proposed action was given by the Migratory Bird Conservation Commission, on May 26, 1930. One of these is a tract of 32,000 acres on the coast of South Carolina, a little north of Charleston, made up of a group of large islands, marshy in character and interlaced with winding channels, all making an area most attractive to the migratory birds that follow the eastern seaboard in spring and fall migrations. Besides being a haunt of several species of ducks, it is noteworthy because of its attractiveness as a nesting area of Wilson's plover and the willet. The ruddy turnstone, the black-bellied plover, and small sandpipers seek this region in their migrations, while colonies of black skimmers, terns, and herons also find haven here. The oyster catcher, a large strikingly colored shore bird, almost extinct by reason of relentless shooting, is present on this area in some abundance and will find sanctuary in the new refuge.

The second unit approved for purchase by the Migratory Bird Conservation Commission is in the San Luis Valley, Colo. This is an area of more than 5,000 acres in the south-central part of the State, where there are several lakes and sloughs in an otherwise arid region. It is of outstanding importance, being the only attractive stopping place for ducks in their migrations through this great intermountain region of the West. A refuge here will do much to conserve the mallards, pintails, and gadwalls that use this line of flight.

BEAR RIVER MIGRATORY BIRD REFUGE

Contracts have been let for construction work and improvements necessary to correct conditions that have proved so destructive to waterfowl in the area of the Bear River Migratory Bird Refuge, in Utah, during the past decade. The first three of the units making up this refuge have been practically completed, and a contract has been let for the remaining two. In addition to the river-control structure, which provides a means of diverting the water supply into either one or all of the five units, there are to be feeder canals leading into each. A massive outer dike approximately 20 miles long will hold back sufficient water to flood about 25,000 acres of land.

The establishment of this important refuge was authorized by act of Congress on April 23, 1928, and on July 23, 1928, following an examination of the land situation there, an Executive order was issued withdrawing all public lands within the zone to be developed. The purpose of this refuge is not only to provide a sanctuary for waterfowl in the seasons of migration, but so to improve the condition of the water as to prevent the heavy mortality among the birds that has occurred in former years, chiefly from alkali poisoning.

In addition to 30,632 acres of public lands withdrawn for refuge purposes, 15,861 acres were acquired during the year at an average cost of $1.55 an acre, and 7,861 acres were taken under lease. Of the leased lands, 7,126 acres will shortly be acquired in fee by the United States through the exchange of public lands in the vicinity of the refuge that are not used for refuge purposes, authorized by the special exchange act of February 15, 1929, passed in aid of this project. In addition the State of Utah has ceded jurisdiction over 2,133 acres of its land within the limits of the project. The total area now under control, including that to be flooded, is approximately 56,487 acres. Except for the completion of the steps required incident to the actual transfer of the lands under exchange agreement previously referred to, the acquisition of all lands within the Bear River Migratory Bird Refuge has been completed.

CHEYENNE BOTTOMS MIGRATORY BIRD REFUGE

By act of Congress, approved June 12, 1930, the Secretary is authorized to acquire 20,000 acres of land in what is known as the Cheyenne Bottoms, in Barton County, Kans., for migratory bird refuge purposes. This area consists of a natural depression in an otherwise prairielike region, and contains the only extensive lake in the State. The Biological Survey had previously made exhaustive investigations as to the suitability of the site for this purpose and had also made an intensive economic survey of it.

The body of water on this area is the objective of immense numbers of migratory wild fowl and shore birds in their semiannual flights. It is the most suitable haven for them within a radius of hundreds of miles. Because of the unusual ownership and title situation here, apparently precluding acquisitions by direct purchase from the owners, it would seem necessary to resort to condemnation proceedings to vest safe title to the property in the United States. Funds were made available to the Biological Survey for initial steps toward the consummation of measures for the acquisition of the refuge effective July 1, 1930.

MIGRATORY BIRD CONSERVATION COMMISSION

The Migratory Bird Conservation Commission was created by the migratory bird conservation act of February 18, 1929 (45 Stat. 1222), to consider and pass upon areas of land, water, or land and water that may be recommended for purchase or lease by the Secretary for refuge purposes. The commission consists of the Secretary of Agriculture as chairman, the Secretary of Commerce, the Secretary of the Interior, Senators Peter Norbeck and Harry B. Hawes, and Representatives Ernest P. Ackerman and Sam D. McReynolds. The commission held its first meeting on May 15, when it considered methods of approach to the accomplishment of the refuge program and completed its organization by the appointment of Rudolph Dieffenbach, in charge of the division of land acquisition of the Bureau of Biological Survey, as its secretary. A second meeting was held later in the month when a detailed purchase policy was formulated and approved, and reports submitted by the department were considered and approved on the two refuge sites for which options had previously been taken, the average price consideration for the two areas being $1.13 an acre.

The next meeting of the commission is scheduled to be held in December, when other matters for its attention will have matured.

MAINTENANCE OF WILD-LIFE RESERVATIONS

The movement so pronounced last year for the establishment of refuges for the restoration of wild life has been continued, as evidenced by both Federal and State action. This form of conservation may well be considered one of the best established principles in wild-life administration. Its importance will be enhanced as both Federal and State funds are made available for the care and maintenance of areas dedicated as wild-life sanctuaries. Sound plans for the administration of sanctuaries include not only adequate policing but also the development of food resources and the maintenance or provision of a sufficient supply of water and other needs of individual refuges as affected by local conditions. The degree to which these requirements are met often determines the success that may be expected in attaining the objectives of sanctuary areas.

Difficulties arising through surplusage of animals on some of the existing big-game preserves have now been reduced to a minimum by systematic effort, and future control of the numbers of animals should be easier. It has become evident that when additional funds are made available for the construction of corrals and wing fences

the capture of surplus animals will be further facilitated. The numbers of big-game animals and their increase on preserves administered by the Biological Survey at the close of the year, other than on the Elk Refuge, are given in Tables 1 and 2. The herds are generally in good condition.

To aid inquirers in obtaining exhibition stock of big-game animals when the surpluses on preserves of the Biological Survey were not ample to fill all requests received, a mimeographed leaflet (Bi–1057) was issued listing, in addition to these and other governmental preserves, the names of dealers in live big-game animals.

A list of all wild-life reservations administered by the Bureau of Biological Survey, together with lists of bird refuges and game preserves on areas administered by other branches of the Federal Government, was issued during the year as Miscellaneous Publication No. 51.

BIG-GAME PRESERVES

NATIONAL BISON RANGE

A system of rotation grazing for the buffalo on the National Bison Range, near Moiese, Mont., made possible by the completion last fall of a division fence, should result in great benefit to the forage on the range, a portion of it already being in better condition than for a number of years. Disposal of surplus animals was continued to meet the grazing capacity, and during the year 107 buffalo and 36 mule deer were removed. Of the buffalo, 104 were sold for meat, and 3

TABLE 1.—*Animals on big-game preserves of the Bureau of Biological Survey, June 30, 1930*

Preserve	Buffalo	Elk	Antelope	Mountain sheep	Deer		Total
					White-tailed	Mule	
National Bison Range, Mont.	320	[1] 151	----	37	[1] 10	[1] 110	[1] 628
Wind Cave Game Preserve, S. Dak.	152	[1] 28	29	----	----	----	[1] 209
Sullys Hill Game Preserve, N. Dak.	13	30	20	----	3	----	66
Niobrara Reservation, Nebr.	117	[1] 113	15	----	1	----	[1] 246
Total	602	[1] 322	64	37	[1] 14	[1] 110	[1] 1,149

[1] Estimated.

TABLE 2.—*Young of buffalo, antelope, and mountain sheep born on reservations of the Bureau of Biological Survey during the calendar year 1929* [1]

Preserve	Buffalo	Antelope	Mountain sheep
National Bison Range, Mont.	67	----	13
Wind Cave Game Preserve, S. Dak.	28	[2] 2	----
Sullys Hill Game Preserve, N. Dak.	3	8	----
Niobrara Reservation, Nebr.	20	4	----
Total	118	[2] 14	13

[1] Figures omitted for young of elk and deer, as estimates only could be made.
[2] Estimated.

were removed alive for exhibition in parks and elsewhere. Of the deer, 35 were sold and shipped alive for park and propagating purposes, and 1 accidentally killed was sold for meat. The buffalo calf crop was better than last year, notwithstanding the fact that the total number of buffalo on the range is smaller than at the close of the previous year.

The elk herd shows a steady increase, but a number of the deer died last winter as a result of the severe cold. The herd of mountain sheep has been reduced to 37 animals by heavy losses that were apparently occasioned principally by a disease diagnosed by veterinarians of the Bureau of Animal Industry as chronic broncho-pneumonia. The fact that no carcasses have recently been found on the range would indicate that the disease has about run its course and that the sheep will again begin to increase in numbers.

ELK REFUGE

The number of elk that came to the feeding grounds at the Elk Refuge, in Jackson Hole, Wyo., during the winter varied at times from 4,000 to 7,000, some returning to the adjoining ranches and foothills whenever the weather turned warm. Only 4 were seen on the refuge before the hunting season closed, but by the end of December there were approximately 5,000 on the feeding grounds and in their immediate vicinity. Feeding, both by the bureau and the State game department, did not begin until February 6, and ended at the refuge on March 23, the State finishing feeding on the Sheep Creek foothills section on March 26. During the feeding period considerable warm weather was experienced, and at no time was the average depth of snow more than a foot. The open winter and the fact that the animals were widely scattered made it impossible to obtain an accurate count of the herds.

Approximately 825 tons of hay were fed, including that used for the work horses. Of this, 510 tons had been purchased by the State, and 315 tons were from the supply produced on the refuge. At the close of the feeding season, the bureau had 1,300 tons remaining, and the State 240 tons. Thus, 1,540 tons are available for feeding next winter. Nine hundred tons of hay were harvested on the refuge, including the Izaak Walton League addition, in the summer of 1929. A cold spring and an unusually dry summer combined to reduce the crop to about three-fourths of the normal yield. The forage on the open range and pasture was in far better condition during the early summer of 1930 than a year ago, and a larger hay crop is in prospect the coming fiscal year.

The elk came through the winter in exceptionally good condition with few losses from any cause, both on the feeding grounds and in the outlying districts. A corral has been constructed, and eight animals, captured early in the spring, are being held for study and experimental purposes. Representatives of the Bureau of Plant Industry visited the refuge last summer and made an examination of the hay meadows for the purpose of devising a plan for the control of squirreltail grass and for increasing forage production.

SULLYS HILL GAME PRESERVE

Two young male white-tailed deer were brought to the Sullys Hill Game Preserve, N. Dak., from the Upper Mississippi River Wild Life and Fish Refuge, and the antelope herd was increased by the birth of five fawns. Two antelope died apparently from mouth injuries received from eating oats that contained the seeds of the wild variety. The lesions occasioned by this feed abscessed and eventually resulted in death of the animals most severely affected. To restrict the big-game herds to conform to the carrying capacity of the range, three buffalo and eight elk were removed during the year. Of the buffalo, two were shipped alive for propagating purposes, one of them to the State Game and Fish Commission of Arizona, and one was sold for meat. Of the elk removed, 1 was shipped alive for exhibition purposes, 6 for breeding purposes, and 1 for meat.

The work of fencing an exhibition pasture has been completed to inclose about 16 acres, divided into three parts for elk, buffalo, and antelope, respectively. The preserve was visited during the year by 20,764 persons, with 4,825 automobiles.

WIND CAVE GAME PRESERVE

Forage was abundant in the pastures on the Wind Cave Game Preserve, S. Dak., during the year, and water was plentiful most of the time. Surplus animals disposed of included 61 buffalo and 25 elk. Of the buffalo, 38 were shipped alive and 23 butchered. Five of those shipped alive were gifts to municipal parks and zoological gardens, 10 were furnished for stocking purposes to the States of Arizona and South Dakota, and 23 were sold for propagation. Of the 25 elk removed, 11 were shipped alive for propagation and exhibition purposes, and 14 were sold for meat. Predatory animals are well under control about the preserve. Sharp-tailed grouse are more common than last year, and Chinese pheasants are reported occasionally.

NIOBRARA RESERVATION

The Niobrara Reservation, near Valentine, Nebr., is important both as a game preserve and as a bird refuge. Grouse have not returned to normal abundance from the setback of a few years ago, but are slowly recovering; ring-necked pheasants are gradually spreading into the region of the reservation, but quail appeared to be decreasing. Experiments in raising wild turkeys have not been wholly satisfactory, since their roving habits make it impossible to keep them within the boundaries of the reservation. In winter wild ducks in large numbers take refuge on the small ponds of this preserve. One of the ponds is near the highway that crosses the reservation, and the ducks can be seen by travelers in passing cars. This condition affords an interesting educational feature in connection with the preserve and has established a favorable local impression regarding the value of the refuge and the importance of game conservation. Surplus big-game animals removed during the year included 7 buffalo and 19 elk, all sold for meat. The animals now on the reservation and the range are in good condition and include three sets of twin antelope fawns. Predatory animals are not so

abundant as in former years, but the fences surrounding the pastures near headquarters in which the antelope range have been made coyote proof.

BIRD REFUGES

All but 1 of the 86 wild-life reservations administered by the Biological Survey in the United States, Alaska, Hawaii, and Porto Rico are duly constituted bird refuges. These include the 4 big-game preserves, the elk refuge, and an island reservation in Alaska for conducting experiments in the propagation of reindeer and caribou, the exception being 1 muskrat and beaver preserve in Alaska. Wild life generally is protected on these, but 2 are especially for mammals, birds, and fishes, while 77 are maintained primarily for birds.

NEW REFUGES

Four new bird refuges were established during the year: (1) Cedar Keys Refuge, off the west coast of Levy County, Fla., embracing Snake Key, Dead Man or Bird Key, and North Key, in the island group known as Cedar Keys, will serve as an important nesting and wintering ground for considerable numbers of aquatic birds, including several species of herons, pelicans, and cormorants, some of which were becoming greatly depleted in numbers. (2) Benton Lake Refuge in Cascade and Chouteau Counties, Mont, near the city of Great Falls, embracing an area of more than 12,000 acres, constitutes an important sanctuary for great numbers of migratory waterfowl. More than 3,000 acres of the refuge is water area, with an abundance of aquatic plant growth for cover and food for wild fowl. Several species of wild ducks, as well as wild geese, are found on the Benton Lake marshes during their migration, and some of these birds breed there. Shore birds also frequent the region, chiefly in migration. (3) Salt Plains Wild Life Refuge, comprising approximately 20,000 acres in Alfalfa County, Okla., will constitute an important link in the network of refuges to be established throughout the country under the migratory bird conservation act. (4) Wolf Island Wild Life Refuge on a portion of Wolf Island, off the coast of Georgia, between Doboy and Altamaha Sounds, which was formerly used by the Department of Commerce as a lighthouse station, is valuable as a resting, feeding, and breeding ground for waterfowl and other aquatic birds.

HAWAIIAN ISLANDS RESERVATION

Arrangements were completed this year for the protector to visit Laysan Island of the Hawaiian Islands Bird Reservation early in the coming fiscal year for the purpose of inspecting wild-life conditions there. The widely scattered units of the reservation render it impossible to provide for regular inspection of all the areas in the absence of special equipment necessary for adequate patrol purposes.

LAKE MALHEUR BIRD REFUGE

The extremely dry season in the region about Lake Malheur Bird Refuge, in Oregon, has resulted in greatly restricting its water area,

which may reach a lower stage than during any season in the past decade. Investigations have been conducted at this point to determine the possibilities of augmenting the present water supply or of developing an independent supply to care for the needs of the reservation. The question of ownership of lands in the lake bed and its immediate vicinity continues to be a serious obstacle to further development of this refuge. A bill that has been pending in Congress for several years to authorize litigation on this subject was passed, but owing to the fact that it involved the determination of water rights throughout the entire drainage system, its veto was recommended by the Attorney General. He suggested, however, that the purpose of the legislation might be accomplished without the aid of a special act. Because of the importance of this refuge to the waterfowl situation in the northwestern portion of the country, it is desirable that development work be undertaken at the earliest possible date.

ALEUTIAN ISLANDS RESERVATION

Need for extensive repairs to the boat *Seal* caused a postponement to the summer of 1931 of a tour of inspection of the Aleutian Islands reservation planned by the Alaska Game Commission. No important inspections have been made of the greater part of this reservation for several years, and the information to be obtained by a general tour to the Aleutian Chain will be of great value in future administration. By the granting of provisional permits, natives of the islands have been encouraged to undertake the propagation of foxes where such operations would not interfere with the welfare of birds. Plans also have been advanced for the transfer of the direct administration of this reservation to the chief representative of the Biological Survey in Alaska.

BIG LAKE BIRD RESERVATION

Thousands of ducks, such as mallards, scaups, teals, pintails, and other varieties, have used Big Lake Reservation, Ark., as a resting place and feeding ground this year. With its outlying sloughs this area is an important nesting and breeding ground for wood ducks and hooded mergansers. An increase in the number of wood ducks has been noted, more than 4,000 having been seen on the refuge this summer. Many egrets, herons, mourning doves, and woodcock use the refuge as a resting and feeding ground, and killdeer, sandpipers, and yellowlegs have also been numerous, as well as many species of insectivorous birds. Preliminary plans were made during the year that, if carried out, will make it possible to maintain the water in the lake at a satisfactory level.

UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE

Progress in rounding out refuge areas and in broadening administrative control on the Upper Mississippi River Wild Life and Fish Refuge was made during the year. Some interruption of acquisition activities has occurred, but the indications are that a substantial part of the remaining lands desired will be acquired during the coming year.

Practically no restocking operations were undertaken during the year, though studies of former stockings were carried on to learn what can be expected from this work. The information at hand indicates that there is a splendid opportunity to carry on a broad and constructive plan of rehabilitation of the refuge area. From former plantings of beavers, there are now four well-established colonies of these valuable fur bearers within its boundaries. The animals appear to be doing well and additional introductions will be made early in the coming year.

Entirely satisfactory results from experiments with the waterfowl colony maintained on Lake Winona are not being obtained, owing to lack of complete control over the shore line. The increases in the number of birds maintained there have been reasonable, and Canada geese there mated this year for the first time since the refuge was established. Several mature mallard ducks were removed from the experimental pens to refuge territory in the river bottoms, where they were released during the spring with a view to having them rear broods of young under natural conditions. A small quantity of grain is being fed to hold the birds near the place where released.

Approximately the same inviolate sanctuaries were maintained throughout the refuge area as during the preceding year, and encouraging reports have been received regarding their effectiveness. Wood ducks appear to be making satisfactory increases throughout the entire length of the refuge, and each year more of these birds are found breeding there.

More muskrats were on the refuge and on immediately adjoining territory during the summer and fall than has been the case for many years, though a large number later perished as a result of the extremely low water throughout the Mississippi Valley, many animals starving during the winter. During the spring trapping season of 30 days, 728 permits were issued authorizing trapping on refuge lands, reports on which, though incomplete, indicate that approximately 23,000 muskrats were taken. Special permits continue to be issued for various activities that may be allowed on refuge lands without detrimental effect.

River pollution through the refuge area continues to present a vexing problem. Investigations made during the year by the Bureau of Fisheries and local agencies, as well as by the Biological Survey, disclose that the pollution in the river as far south as Trempealeau, Wis., is sufficient to be detrimental to fish life. Studies also show that sources of pollution on the river are to be found in city sewer systems and industrial plants and in oil discharged from river vessels.

Hearty cooperation continues between refuge employees and State officials. Patrol activities have been gratifying in that substantial increase in the number of apprehensions is shown over the preceding year. This does not indicate an increase in the number of offenders but is a direct result of the development of a more efficient patrol on the part of the refuge organization.

A marine railway with four steel trucks, constructed within the refuge at La Crosse, Wis., provides means of dry-docking the refuge boats for winter storage and repairs. Four ranger cabins were constructed at strategic points on the refuge, and outboard motors and small boats have been provided for the rangers as efficient and economical means of transportation throughout the refuge. During the

extremely low stage of water in the spring of 1930 a serious fire hazard prevailed, but the small refuge organization was able to control the situation effectively.

Progress on the purchase of refuge lands has been less rapid than in previous years, as tracts to be acquired are either being held at high prices or titles are so involved legally that acquisition other than by condemnation seems impossible. Land acquisitions were further complicated during the year when reports became current of the contemplated construction of numerous dams within the refuge boundary to raise the water level and establish a 9-foot channel on the upper reaches of the river. It is too early to anticipate the effect this would have on the development of the refuge, either in relation to the areas already purchased or on the value of the land to be acquired.

The total area of land under control, including accretions and acquisitions and also State-owned land not conveyed to the United States, is 106,823 acres. The many sloughs, ponds, and lakes intermingled with the lands under control contain an estimated area of 16,023 acres, making the total land and water acreage of the refuge 122,846 acres. This does not include any of the main channel of the Mississippi River within the exterior limits of the refuge, estimated to cover approximately 70,000 acres of water. Approximately 20,000 acres of land remain to be acquired before the refuge will be completed. The price of all lands purchased up to this time has averaged $6.29 an acre. The funds authorized for this acquisition of lands, aggregating $1,500,000, should be ample to complete the purchase of all tracts contemplated under the act.

ADMINISTRATION OF CONSERVATION LAWS

CHANGES IN REGULATIONS

During the past few years it has been found that conditions have been increasingly adverse to the welfare of the wild fowl. Water regions have been reduced by drought and drainage. The numbers of hunters have been constantly increasing. Improved roads and the widespread use of automobiles and motor boats have made it easier for gunners to reach regions where formerly the birds were unmolested. The devices used in hunting are increasingly effective. Undoubtedly, also, agricultural developments in this country and in Canada are materially limiting the breeding and feeding grounds formerly used by the birds. Studies made by the Biological Survey during the past three years also indicate that the wild fowl have not been holding their own and that additional measures for the protection of the ducks and geese must be adopted if their numbers are to be maintained.

In considering the availability of methods to insure the welfare of migratory birds, three measures that can be adopted are outstanding: (1) An increase in the production of the birds; (2) provision of resting and feeding sanctuaries for them in their migratory flights; and (3) restriction of the annual kill by hunters. Since results under the first two can be accomplished only after a period of years, the only immediate relief that seems feasible is to reduce the numbers of birds that may be taken during the hunting season. It is evident

that the sportsmen themselves must exercise further restraint if wild-fowling as a sport is to continue.

In line with this reasoning an important change was made in the regulations under the migratory bird treaty act just before the end of December, whereby the bag limits allowed hunters are reduced, effective at the beginning of the hunting season of this year. In the case of ducks the reduction is from 25 to 15 a day, and of geese, from 8 to 4 a day, and a possession limit of two days' bag is prescribed. These changes should lessen the aggregate kill on important winter concentration areas throughout the country.

During the coming hunting season the effect of the new amendments will be watched carefully by the Biological Survey. It is possible that additional restrictions may be found necessary to safeguard the birds—contingent upon the failure of these new regulations to accomplish the desired result. Among other methods that have received the consideration of the bureau are shortening the open seasons, establishing rest days, making further restrictions in the use of devices now allowed in the taking of ducks and geese, and limiting the artificial methods of luring birds within range of the shooting stands. If additional changes should be recommended, it will be only after the most careful study of all phases of the situation. In recommending the most recent changes the bureau was governed by this principle, and while extremists on both sides were in many respects inclined to criticize the action taken, it has been very generally appreciated that it was necessary for the bureau to proceed conservatively—not so rapidly as some urged and yet more drastically than many opponents of hunting restrictions desired—and the response has been very favorable on the part of hunters, conservationists, and the people generally.

ENFORCEMENT PERSONNEL

Though the difficulties of administration of the regulations under the migratory bird treaty act have greatly increased during the past 10 years, there has not been a proportionate strengthening of the enforcement arm. The increasing use of automobiles, motor boats, and airplanes to reach the hunting fields and to aid in such illicit practices as market gunning, night shooting, the snaring of ducks, and other violations has added immeasurably to the task imposed on the regular field force, consisting of only 25 United States game protectors.

The need for a force of game protectors, carefully trained, ably supervised, and sufficiently numerous adequately to enforce reasonable restrictions and thus to control the yearly kill of wild fowl is so important as to warrant its consideration as an emergency requirement. Each passing season records increasing contempt on the part of game-law violators for the Federal regulations designed to protect migratory birds. This deplorable condition is due to the general knowledge that in this matter the Federal Government is not fully equipped to carry out its obligations. Many law-abiding sportsmen and citizens who are interested in the preservation of American wild life are outspoken in their opinion that the Government is negligent of this resource, and they view the future of our migratory birds with dismay and discouragement.

It is to be borne in mind that the generous efforts of Federal and State Governments to establish wild-fowl sanctuaries and to eliminate and control disease and predatory creatures will prove futile if the illegal killing and sale of migratory game birds is not reduced far below the present totals. This can be accomplished only through the agency of an enforcement personnel numbering not less than three protectors where there is now one, and consisting of officers equipped with facilities to enable them to encounter the willful violator on somewhat equal grounds. Material help would be afforded if all persons would use their influence to encourage observance of the law, and would report violations without favor.

LAW VIOLATIONS AND PENALTIES

The handling and disposal of cases of violation of the migratory bird treaty act during the year are shown in Table 3. Of cases reported by United States game protectors and United States deputy game wardens, 93 were not forwarded for Federal prosecution because of lack of sufficient evidence, youthfulness of the accused, adequate fines in State court, or other satisfactory reasons. Federal judges imposed fines ranging from $1 to $2,700 and jail sentences in 14 cases. The aggregate of fines and costs was $10,758.43. One defendant was sentenced to 1 hour and another to 1 day in custody of the marshal, and jail sentences of from 30 days to 6 months were imposed in 12 cases.

Plumage and migratory game birds of an estimated market value of $3,000 were confiscated. The game birds in the majority of instances were donated to hospitals and other charitable institutions for use as food; the plumage was utilized for scientific and educational purposes.

The penalty of $2,700, which was imposed in Federal court in Maine, represents the largest total of fines ever assessed at one time against an individual for violations of the treaty act. In December a man hunting in that State, aided by his employees, killed 90 eider ducks, on which, under Federal regulations, there is no open season at any time of year. Upon the defendant's plea of guilty, the court imposed a fine of $30 for each eider duck killed.

Four cases involving hunting from an automobile were reported during the year, the first in which this practice has been outlawed by the regulations, and three of them have been successfully terminated. A number of complaints regarding the hunting of migratory

TABLE 3.—*Cases of violation of the migratory bird treaty act disposed of during the fiscal year 1930, and cases still pending*

Cases disposed of	Number	Cases pending	Number
Convictions	305	Pending from former year	454
Dismissals	80	New cases reported	303
Verdicts of not guilty	4		
No bills found	1	Total	757
Nolle prosse	13		
Death of accused	4		
		Disposed of	407
Total	407	Pending at end of year	350

waterfowl from airplanes were received, and evidence was obtained against four persons and the cases were forwarded for prosecution.

Prosecutions have been instituted against 18 persons for hunting and trapping on the Upper Mississippi Wild Life and Fish Refuge in violation of the regulations under the act creating this reservation. During the year 9 new cases were filed and 4 were terminated by fines of $25 each; 2 had previously been disposed of by fine; and the remainder are pending. Reservation wardens apprehended 61 persons who were violating State game laws on the refuge—45 in Minnesota and 16 in Wisconsin. These cases were terminated by fines and costs aggregating $2,576.44. Nine persons found guilty were required to serve jail sentences, some of 30, some of 45, and some of 60 days.

Thirteen new cases were filed in Federal court for alleged violations of section 84 of the United States Criminal Code protecting wild animals, including birds and their eggs, on Federal refuges in general. Three cases were closed, two by fines of $5 each, and the third by a jail sentence of 90 days.

CONSERVATION THROUGH EDUCATION

Despite the comparatively limited efforts the Biological Survey has been able to exert in the enforcement of Federal bird-conservation laws, by reason of its small force of game protectors, it has been active in disseminating information on the needs in the matter and has enjoyed the support and cooperation of many State conservation commissions, sportsmen's organizations, and individual conservationists. Game-law administration is thus not confined entirely to the apprehension and prosecution of violators, nor to the enforcement of other provisions of such laws. The dissemination of information of educational value may be of even greater importance in the scheme of conservation than are arrests and convictions. The United States game protectors and other field men of the Biological Survey constitute a most valuable educational force by reason of their varied personal contacts and the opportunities afforded them of addressing meetings of sportsmen and others, and of discussing at first hand matters affecting hunting conditions, game-law enforcement, game replacement, and conservation in general.

The press of the country has given wide publicity to statements issued by the bureau, and many of the sporting periodicals have reproduced in their pages the bureau's annual poster (No. 48–Bi) on open-season dates. One of these periodicals included by purchase from the Public Printer a copy of the poster as a supplement to each copy of a fall issue, the number thus purchased and distributed being larger than the total edition of the poster printed by the department for free distribution, the latter being chiefly for use in public buildings.

Among other publications issued during the year in the interest of bird protection and the conservation of wild-life resources generally were the thirtieth annual Directory of Officials and Organizations Concerned with the Protection of Birds and Game (Miscellaneous Publication No. 57); the annual bulletins on the game laws (Farmers' Bulletin No. 1616) and the fur laws (Farmers' Bulletin No. 1618), and, in the 1930 Yearbook of Agriculture, a statistical table (No.

585) comparing the numbers of hunters' licenses issued for the seasons 1926–27 and 1927–28, and showing the money returns therefrom to the States. The game and fur law bulletins give in a brief but concise form the provisions of both Federal and State laws concerning open seasons, bag limits, license requirements, possession, sale, transportation, and other provisions relative to migratory and upland game birds, game mammals, and fur bearers. These bulletins are widely distributed, it being the endeavor of the bureau to place them in the hands of individuals and organizations that can use them to the best advantage in the cause of conservation.

In addition to these publications and information disseminated through the press service of the department, the need for conservation measures as affecting wild birds and fur-bearing and other mammals has been brought to public attention through radio and other addresses by officials of the Biological Survey and by exhibits at sportmen's shows, and special articles for outside publication. A comprehensive discussion of wild-life conservation was prepared during the year in cooperation with the Bureau of Fisheries of the Department of Commerce, for inclusion as a new chapter of a privately published revised edition of a standard work on the conservation of the natural resources of the country. The first edition of this book had discussed the conservation of such other natural resources as land, water, minerals, and forests. The fact that invitation was thus extended to prepare the added chapter on wild-life conservation is significant of the trend toward increased recognition of the place of wild life in the general scheme of conservation and of the reputation of the bureau in this field. Other educational and reference articles prepared by members of the staff of the Biological Survey on invitation of outside publishers included several for encyclopedias on such subjects as game protection, wild-life reservations, and the work of the bureau in general.

Efficient administration of the bureau's regulatory and law-enforcement work can be accomplished only with the cooperation and support of all interested in wild-life conservation. Wherever this has been given during the year, it has aided the efforts made to create a sound public sentiment in favor of observance of the law, and this can be further supported only by evidence of willingness on the part of sportsmen and conservationists to adopt all restrictions necessary for the preservation of our migratory birds.

NEW SENATE COMMITTEE ON CONSERVATION

On April 17, 1930, there was appointed by the Senate a Committee on Wild Life Resources, consisting of five members, to investigate matters relating to the conservation and replacement of these resources, both land and aquatic, and to determine the most appropriate means to this end. Investigations were begun by the committee during the recess of Congress, and its recommendations will be made to the Senate, involving any necessary changes in legislation to carry out its conclusions. The committee has called upon the Bureau of Biological Survey for information, both in Washington and in the field, and the bureau has cooperated actively to facilitate its operations. The definite and comprehensive program of conservation to be evolved should aid materially in the perpetuation and preservation of our natural resources in wild life.

INTERSTATE COMMERCE IN WILD BIRDS AND MAMMALS

COOPERATION WITH STATES

No Federal prosecutions were instituted during the year for violations of the Lacey Act, which regulates interstate commerce in wild birds and mammals, but extensive investigations under the act were conducted by United States game protectors, many of them in response to requests received from State game departments for information regarding particular shipments. Violations of Federal law in this matter are predicated upon infractions of State law. The work of Federal officers thus becomes a valuable form of cooperation with the States. As a result of the activities of the field forces of the bureau a number of violations of State laws pertaining to traffic in pelts of fur-bearing animals were discovered, and considerable progress was made in discouraging violations, with improvement of conditions in some sections.

Investigations conducted by the Biological Survey at raw-fur centers resulted in furnishing State game-protection officials information regarding 5,249 shipments that apparently contained illegally taken skins. During the year the several States closed by prosecution 689 cases based on information originally furnished by the bureau, in which the aggregate of fines assessed was $23,664.55 and the costs $2,765.50, or a total of $26,430.05.

Jail sentences were imposed against 10 violators as follows: 5 days, 1; 10 days, 6; 30 days, 1; 40 days, 1; 90 days, 1. In seven cases tried before a jury, verdicts of guilty were returned. One violator remitted more than $3,600 to a State game department, representing the amount he had received for illegally shipped beaver skins.

Prosecutions involving violations of State fish and game laws exclusive of illegal shipments of pelts of fur-bearing animals were instituted in local courts in 25 States on information gathered by the field force of the bureau and transmitted to State game officials. Of these cases, 414 were successfully terminated, the fines and costs aggregating $12,964. In addition 6 jail sentences, ranging from 30 to 90 days each, were imposed. This type of cooperation has proved invaluable to many of the States, which have reciprocated with assistance in obtaining evidence concerning infractions of the Federal laws and in other ways.

PERMITS FOR SCIENTIFIC PURPOSES AND PROPAGATION

The permit system adopted under the migratory bird treaty act is designed to allow reputable and qualified individuals ample opportunity for the scientific collection and study of migratory birds. The permittee is subject only to such restrictions as are necessary to prevent the waste or destruction of this resource through activities of such unqualified or unscrupulous persons as have no real scientific object in view or desire to use the permit for purposes not associated with the conservation or legitimate study of wild life.

Similarly, the department desires to promote and encourage the artificial propagation of migratory game birds by individuals and organizations, since in this manner the total supply of some of the most common and valuable species can be greatly increased and a legitimate industry developed. It is obvious, however, that the in-

dustry must be subject to some reasonable control if irresponsible individuals are to be kept from trafficking in wild game birds under cover of a Federal permit and in defiance of the regulation prohibiting sale or purchase of such birds. The business of propagation, sale, and distribution of game species artificially reared is worthy of support and encouragement, but the traffic in wild birds, which was chiefly responsible for the extermination of the passenger pigeon and a decrease in wild fowl generally, is a practice so destructive that it must be checked and repressed at every point. In order that authorities may have a means of distinguishing legitimate operations from illegal ones, individuals who wish to engage in the legitimate and commendable business of game propagation are required to record their qualifications and to report annually all operations under their permits.

The permit system under which migratory game birds may be captured and reared is not only an essential safeguard to prevent the disastrous exploitation of wild stock, but it affords protection to the properly accredited game farm as well. The regulations governing issuance of Federal propagating permits are only such as will accomplish these purposes with the least embarrassment and annoyance to the qualified individual. No fee whatever is charged, either for scientific or for propagating permits. The permit system adopted provides an excellent check on the activities of operators.

The total number of permits issued and outstanding during the year was as follows: Scientific collecting, 1,939; scientific possession or taxidermists', 367; propagation (possession and sale), 3,976. In addition, permits were issued to 98 persons for the trapping of stated numbers of waterfowl for breeding purposes. The reports submitted show that during the calendar year 1929 there were raised in captivity under permit 62,954 waterfowl of various species, of which 57,574 were mallard ducks and 3,734 were geese. Of the total number, 15,107 ducks and 432 geese were killed and sold or used for food, and 5,428 ducks and 2,285 geese sold for breeding purposes.

SEIZURE AUTHORIZATION NEEDED

Furs removed from the jurisdiction of one State and commingled with articles of interstate commerce in another usually are not subject to State seizure. The real solution of the problem of controlling illegal shipments, and thereby contributing to wild-life-conservation programs, seems to lie in an amendment to the Lacey Act that would confer on employees of the department engaged in enforcing its provisions the right to seize illegal shipments of the dead bodies or parts of wild animals.

IMPORTATION OF FOREIGN SPECIES

On May 25 the Bureau of Biological Survey completed 30 years of supervision of importation of foreign birds and mammals under the Lacey Act. Seldom has a Federal law remained on the statute books so long with so little change and with such uniformity in the policy of its enforcement. More than 10,000,000 birds and several thousand mammals have been imported since 1900, but during this time, so far as is known, no injurious species has obtained a foothold in the

United States. On the average about one mongoose a year has gained entrance, but these animals have either been destroyed or in a few cases have been confined for exhibition in zoological gardens. Several consignments of flying foxes have been denied admittance, and other species that might prove injurious have been introduced in small numbers and held in captivity for exhibition under close supervision.

Coincident with the close of the third decade of the operation of the Lacey Act, a new advance in conservation was made by the extension of the principle governing traffic in birds and game captured or shipped in violation of local laws of certain foreign countries. Under section 527 of the tariff act of June 17, 1930, any mammals or birds that are the object of special protection in foreign countries are prohibited from entry into the United States unless accompanied by a consular certificate setting forth that capture and shipment have been duly authorized in accordance with local requirements. This provision will restrict the shipment of certain rare species that are prohibited from export or that are obtained only on certain areas set aside as refuges or wild-life reservations. Heretofore the Biological Survey has had no way of preventing the entry of such consignments as they arrive at the ports of the United States, and the bureau has been subjected to criticism for its inability to prevent such traffic. In future it will be possible to cooperate more fully with foreign countries in this respect, and as the United States is probably the greatest market in the world for live animals and birds, the new legislation should aid materially in the protection of certain species.

The number of importation permits issued during the year was 1,205, a decrease of 49 from that of the preceding year. The inspection of shipments at various ports of entry decreased from 510 to 484. In addition 14 permits were issued at Honolulu, Hawaii, for the entry of 158 miscellaneous birds and 11 mammals. The first consignment of birds and mammals to cross the ocean by air arrived on the dirigible *Graf Zeppelin* from Friedrichshafen, Germany, at Lakehurst, N. J., on August 4, 1929, and included a gorilla, a chimpanzee, and 593 canaries. The total importation of birds exceeded that of last year and was the largest since the issuance of permits began. Of the total number, more than two-thirds were cage birds and more than half canaries. Game birds comprised chiefly Mexican quail, Hungarian partridges, and pheasants. The total number of all foreign birds imported was 825,736, of which 12,191 were without permit, many of them being brought in under declaration of passengers' baggage. Importations under permit comprised 562,980 canaries, 69,673 parrots, 90,124 quail, and 90,768 representatives of miscellaneous species.

MAMMALS

An unusual number of sea elephants was entered during the year. The Zoological Society of San Diego, Calif., obtained authority from the Mexican Government to capture four sea elephants and four fur seals on Guadalupe Island, Lower California, about October 1, and later in the year a shipment of four other sea elephants from the same island arrived for exhibition at Venice, Calif. The South Atlantic sea elephant was represented by two specimens, imported on September 23 and May 10, one of which was acquired by the St. Louis Zoological Gardens and the other by one of the large circuses.

Two gorillas were received during the year; one was brought in by airship and the other, making the fifth alive in the United States, arrived direct from West Africa about May 31. Considerable interest developed during the year in the importation of fitches for propagation in the fur industry and a few animals were brought in. On account of local restrictions regarding related species, these animals can not be imported into some States without special authorization. The high price of the breeding stock serves as a further deterrent to the importation of any considerable number of them.

So far as known, no injurious mammal was entered during the year, but considerable correspondence developed in regard to the importation of European hares. Application was made on December 16, 1929, for the entry of 400 for New Jersey or New York, but as no permit was issued, because of the damage that these animals have done in certain sections of these and other States, the shipment was stopped at Bremen, Germany. Correspondence also developed with the authorities in Michigan relative to preventing the introduction of these hares from Canada. European hares are now established in 10 counties of southern Ontario, but thus far have not gained entrance into Michigan.

The Bureau of Plant Quarantine and Pest Control of California has taken steps to guard against the introduction of species that may become injurious in that State, and to the same end cooperative arrangements by that agency and the Biological Survey have been made to guard against ill-advised importations of mammals.

GAME BIRDS

Hereafter, under the provisions of the new tariff act, game birds for propagation will be admitted free of duty. Though the loss to the Federal Government will be small, several of the State game departments will appreciate the change, as they have always regarded the payment of duty for importing birds for the public benefit as a hardship and an unwarranted expenditure of State funds.

Mexican quail.—Importations of quail from Mexico for distribution chiefly in Pennsylvania, Maryland, Virginia, Kentucky, Texas, Oklahoma, and Kansas were the largest on record, and for the first time the total number exceeded 90,000. The actual number, 90,124, was greater by nearly 3,000 than that of last year. Of these, 9,775 were entered at Brownsville, 61,922 at Laredo, and 18,427 at Eagle Pass, Tex., all being captured under concessions issued by the Mexican authorities to eight individuals, of whom four actually operated at the three ports named. The supervision of importations at the border as heretofore was handled through the Bureau of Animal Industry, and the inspectors issued permits, examined the shipments before entry, and furnished weekly reports on the number entered, with details of destination. No quail disease was reported during the season. The total number of quail imported since 1910 is now 613,311.

Hungarian partridges.—Interest has been renewed in Hungarian partridges during the past few years, and importations have increased steadily. The conservation commission of New York and the game commissions of one or two other States have been importing

these birds for restocking. The total number brought in during the year was in excess of 5,000.

CAGE BIRDS

The importation of cage birds as a whole suffered a serious setback on account of an outbreak of parrot fever late in 1929 and the prohibition of the entry of these birds after January 24, 1930. Not only was the parrot trade greatly reduced in volume, but because of the apprehension of the public the retail trade in other birds was curtailed indirectly in various ways.

Parrots.—The outlook last autumn indicated the largest importations of parrots ever made, beginning early in summer with consignments from Cuba, followed by yellow-headed parrots from Mexico and by Panama parrots and other large Amazons from tropical America. Just before the holidays, when the wholesale trade had passed its peak but many birds were still in the hands of retailers, a mysterious disease, commonly known as "parrot fever," was reported at Annapolis, Md., and was said to have been contracted from parrots recently imported from Colombia through dealers in Baltimore and New York. Wide publicity was given the matter by the press, and reports were soon received from a number of widely separated cities. In all, nearly 200 cases were reported, and a number of them proved fatal.

Through the activity of the United States Public Health Service, steps were at once taken to obtain all available information and to check the progress of the disease so far as possible. Although popularly termed "psittacosis," and generally so called in the press, the present outbreak differed in many respects from that of the original epizootic of psittacosis, which occurred among parrots in France in 1892. During the course of the outbreak in the United States no investigator succeeded in isolating the true *Bacillus psittacosis* in any case in man, but two investigators isolated a strain from parrots. The cause of the parrot fever was apparently a filterable virus. On recommendation of the Public Health Service, an Executive order was issued on January 24 prohibiting the entry of all parrots at any port of the United States or any of its possessions or dependencies, except under regulations of the Secretary of the Treasury. Under regulations issued February 3, the term "parrots" was defined to include members of the family Psittacidae, except macaws, cockatoos, and love birds, or parrakeets. The number of reported cases reached its maximum in January and February, and by the end of April the disease was practically at an end.

The Biological Survey made a careful investigation of the parrot importations of the fall of 1929 and whenever possible traced the origin of individual birds, but in only a few cases was it actually possible to trace the origin of shipments, as, for example, consignments of Panama parrots from Cartagena, Colombia, and certain double yellow-headed parrots from Mexico. Some of the cases in southern California and Hawaii were traced to a tourist steamer, which on a trip around South America took on infected parrots at Port of Spain, Trinidad, and to these birds were attributed cases at Los Angeles and Honolulu. So far as known no case of parrot fever was traced to any birds shipped from the Pacific coast of Central

America or South America, and practically all cases where identity could be established were limited to three or four of the commercial species.

This outbreak of parrot fever, unique in its wide distribution and rapidity of dissemination, has had far-reaching effects not only on quarantine restrictions but on the cage-bird traffic at the principal ports of the world. It apparently originated late in August in southern Brazil and in the Chaco, whence it soon spread to Buenos Aires and other ports. It appeared in Germany in November, and the first cases in the United States, apparently originating from birds that had arrived from northern South America in November, were reported early in December. Importation of the birds was prohibited by Los Angeles and other cities in this country, by one of the islands in the West Indies, by the Island of Guam, and by certain cities in Germany and in Austria. General prohibition of entry in the United States was contained in the Executive order, followed later by a sweeping prohibition in Canada, France, and England.

In the United States practically all cases in which the specific identity of the birds could be ascertained were confined to parrots commonly known as Amazons or to the gray parrot of Africa. The Amazons are natives of tropical America, and representatives of at least 35 of the 50 or more known species have been imported into the United States. Of these only the following are brought in in sufficient numbers to be considered of commercial importance: Double yellow-heads from Mexico; Cuban parrots from Cuba and the Isle of Pines; Panama parrots from ports in Panama, Colombia, and Venezuela; blue-headed parrots from southern Brazil; and white-headed parrots from Nicaragua.

Other cage birds.—Notwithstanding the embargo that prevented the entry of parrots during the last six months of the year, the number of cage birds imported compares favorably with that of previous years. Most of the grass parrakeets now handled by bird dealers are raised in captivity, and many are now produced in California. Of the numerous color phases of these birds that have been developed by crossbreeding, at least 8 have been imported into the United States, and 3 or 4 are now fairly common in the trade. Canaries were imported in large numbers for the holidays, but the trade as a whole was not satisfactory or profitable. In two cases large shipments of canaries suffered heavy mortality or were a total loss. These consignments arrived on successive trips of the same steamer, and the losses were finally attributed to poisoning by fumes from chemicals forming part of the cargo, which caught fire on board.

Among the more noteworthy of the rare and interesting birds imported, some of them for the first time, may be mentioned 45 birds of paradise, representing seven genera; 21 red-breasted geese (*Branta ruficollis*); 3 dwarf turtle doves (*Oenopopelia tranquebarica humilis*); 2 cassowaries (*Casuarius violeicollis*); 38 Kuhl's lories (*Vini kuhli*), from Washington Island in the Pacific, the first ever brought into the United States; 1 blue-streaked lorikeet (*Eos reticulata*); African hawks and owls, including 1 hawk eagle (*Hieratus spilogaster*) and 6 African eagle owls (*Bubo africanus*); 6 dragon, or crested, starlings (*Galeopsar salvadorii*); 2 amethyst starlings (*Pholidauges leucogaster*); and 3 Venezuelan humming birds (*Chrysolampis mosquitus*).

CONSERVATION OF WILD LIFE IN ALASKA

The policy of recommending as few changes as possible in the regulations affecting game and fur-bearing mammals and game birds in Alaska has been pursued both by the Alaska Game Commission and the Bureau of Biological Survey, with the result that the hunting and trapping seasons for 1930–31 in the Territory were altered in only a few particulars to meet local conditions.

BIG-GAME ANIMALS

The amendment affecting the open season on large brown and grizzly bears, whereby residents of Alaska, except in designated areas and islands along or adjacent to the southern coast, are allowed to kill these animals at any season of the year, evoked considerable comment. The Alaska Game Commission had received numerous complaints of damage by bears to livestock and property, and the killing of a Forest Service ranger by one of these animals on Admiralty Island had greatly aroused the public in many other sections and brought about insistent demands for the removal of protection from these bears throughout the Territory. Both the commission and the bureau in dealing with the problems ordinarily arising in wild-life conservation have consistently followed the policy of giving the mammals and birds any benefit of doubt that might arise in regulatory adjustments. Evidence that human life and property are jeopardized in certain sections, however, has made it impossible to adhere strictly to this defined policy in the case of the large brown and grizzly bears in the greater portion of the Territory. It is to be borne in mind, however, that the exemptions apply only to residents of Alaska and not to foreigners or nonresidents. No change except in the reduction of the bag limit from three to two a season was made in the regulations affecting hunting of bears by other than residents.

The effect of the new regulations, both with respect to the conservation of the bears and the protection of life and property in the Territory, is being carefully watched, with a view to giving all possible safeguards to the bears without increasing the hazards to life and property.

Other changes affecting big game include closing the season on deer in parts of southeastern Alaska, slightly shortening the season in the portion of the Territory remaining open to deer hunting, and slightly lengthening the season on mountain goats, but reducing the bag limit from three to two goats a season.

Closed areas established by the new regulations include the Keystone Canyon areas paralleling the Richardson Highway, where all big game and birds are protected, and on the Steese Highway, where caribou are protected.

The privilege granted north of the Arctic Circle of taking caribou throughout the year was extended to include the region north of the Yukon River, in order that residents there also might obtain needed supplies of fresh meat. The caribou herds remain in excellent condition, and it is not deemed that the extension of the privilege to this additional area will be a menace to the continued welfare of the herds.

MIGRATORY BIRDS

The daily bag limits on ducks and geese were reduced to conform with recent amendments to the Federal migratory bird treaty act regulations, and the possession limit of 75 waterfowl heretofore prevailing in the Territory was reduced to 50, which, however, may not include more than 30 ducks and 8 geese.

FUR-BEARING ANIMALS

By an amendment to the regulations affecting fur-bearing animals, marten trapping is authorized this year for the first time since before the enactment of the Alaska game law of 1925. The seasons will run concurrently with those on other fur bearers in the various districts. Each trapper, however, is limited to a seasonal catch of 10 martens throughout the Territory, and it is required that the pelts be sealed as heretofore provided in the regulations for beavers and martens taken within or coming from outside the Territory.

Minks have shown sufficient increase to justify renewal of trapping in certain portions of Alaska where the season was formerly suspended. These include the Kenai Peninsula and most of the area north of the Arctic Circle. In response to requests of fur dealers and trappers, the mink season was closed in the regions comprising the drainages to Bering Sea and Norton Sound in the lower Yukon River region.

The spread of wolves and coyotes in the Territory led to an amendment to the regulations whereby the Alaska Game Commission may issue permits to qualified persons to trap these animals during the close season on fur bearers. To facilitate the enforcement work of the commission, however, traps set for these predators must be marked for identification.

Statistics compiled from reports of shipments of furs from Alaska show a total of 297,448 in 1929, which is 38,629 less than for the previous year. The skins in 1929, however, were valued at $4,513,864 as against $4,298,627 in 1928. The kinds of furs of which increased numbers were exported in 1929 include red fox, white fox, lynx, mink, and weasel. The notable decrease in the number of beaver skins exported in 1929—1,547 as against 32,712 for 1928—is to be attributed to the closing of the season on beaver in 1929, and this decrease nearly accounts for the total decrease in skins of all species exported.

PUBLIC INFORMATIONAL WORK

The informational work of the Bureau of Biological Survey is so conducted as to make available to the public pertinent information as developed in research work, conservation and law-enforcement activities, and pest-control operations. It consists, in addition to direct correspondence and the distribution of bulletins, leaflets, and other publications, of the preparation of technical and popular reports and other articles for official and outside publication, the delivery of addresses before conservationists and others in convention, the preparation of manuscript radio talks for delivery in person by officials or manifolded for broadcast by radio-station announcers, and the dissemination through the press service of the department

and otherwise of items on wild life for scientific, outdoor, and other periodicals, and for the daily and weekly press of the country. In addition, cooperative publication is encouraged by State and other agencies of some of the more lengthy reports on researches conducted by the Biological Survey on a state-wide or more restricted scale, including reports on the birds and mammals of States and other major areas. A further means of informing interested groups of the public on matters concerned with the native and other wild animals and birds of the country, and one widely employed by the bureau, is the use of motion pictures, lantern slides and other illustrative material, and special exhibits.

In all this work it is the aim to supply accurate and dependable information to counteract so far as possible the tendency to that form of exploitive writing ordinarily termed "nature faking." The wealth of data in its files, based on observations and investigations of field naturalists, biologists, and other scientific workers over a period approaching half a century, places the Biological Survey in a responsible position in these matters and involves extensive correspondence from individuals and organizations interested in the many phases of wild-life study, control, enjoyment, and conservation.

Technical reports on research in the geographic distribution and classification and relationships of mammals and birds are contained in the series of the North American Fauna of the Biological Survey, while other technical and popular reports are issued in the various series of bulletins, circulars, leaflets, and miscellaneous publications of the department. Miscellaneous Publication No. 49, issued early in the year, a Directory of Field Activities of the Bureau of Biological Survey, with a map, listed the field offices by State and locality within the State, indicated the nature of services there rendered or research conducted, and gave the name and designation of the official in charge. Details regarding the various other publications, special exhibits, and other informational data have been presented in connection with the discussion of pertinent subject matter in this report.

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